CONFERENCE NUMBER.

Vol. XX. Part I. February, 1949

THE

TEA QUARTERLY

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THE JOURNAL

OF THE

TEA RESEARCH INSTITUTE

OF CEYLON.

Edited by

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Director, Tea Research Institute.

THE TEA RESEARCH INSTITUTE
St. Coombs, Talawakelle.

PRINTED BY H. W. CAVE & CO., LTD., COLOMBO.

The Tea Research Institute of Ceylon.

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NOTE

The Laboratories of the Institute are situated at St. Coombs Estate, Talawakelle, and letters and enquiries should be addressed to the Director Tea Research Institute of Ceylon, St. Coombs, Talawakelle. Telegraphic Address :—Research, Talawakelle, Telephone, Talawakelle 44 (Private Exchange) It is particularly requested that letters should not be addressed to officers by name.

T. PETCH

Tom Petch, B.A., B.Sc. died at his home at Wootton in England on Christmas Eve at the age of 79. His passing will be felt as a great loss to British and Tropical Mycology.

He came to Ceylon in 1905 as Mycologist to the Royal Botanic Gardens. On the retirement of Dr. J. C. Willis in 1912, he assumed responsibility for systematic botany as well as mycology in the newly-constituted Department of Agriculture. He relinquished that post in 1925 to become the first Director of the Tea Research Institute of Ceylon. He retired in 1928 to rejoin his family in England after spending twenty-three arduous years in Ceylon.

On arrival in Ceylon his attention was immediately directed towards the disease problems of plantations crops, cacoa, coconut, tea and rubber. At that time the planting of rubber trees was booming and he devoted much time to the study of the problems of that expanding industry. In 1911 he published "The Physiology and Diseases of Hevea brasiliensis," and in 1921 a revised and more complete account of the diseases of that tree under the title "Diseases and Pests of the Rubber Tree." His tea book "The Diseases of the Tea Bush" was not published till 1923, but meanwhile numerous articles on the diseases of many economic crop plants appeared in the pages of the Tropical Agriculturist. As his work became known to agriculturists in the tropics and to Scientific Institutes, Peradeniya became a recognised centre of mycological knowledge, and requests for advice and assistance were received from many parts of the world.

Although Petch will be best remembered by the planting community for his work on the diseases of plantation crops his interests extended far beyond pathology. He was a born naturalist with interests in all living things but with a special liking for fungi. His first paper on New Ceylon Fungi appeared in 1906 and his revisions of Ceylon fungi started in 1907. Since then there has been a long succession of papers, his object being to describe accurately all known fungi of Ceylon. It was a large undertaking, but with it he established Ceylon mycology on a sound foundation. Later he became especially interested in entomogenous fungi and his work in that sphere established his reputation as a world authority.

Petch's knowledge of the Ceylon flora was very extensive. Although mycology was his main study he yet found time to devote to systematic botany. His papers on Aristolochia, Cryptogyne, Gregarious flowering, Buttress roots, etc., indicate the diversity of his interests.

Mycology was originally Petch's hobby, and after it became his profession it still remained his hobby. His out-turn of scientific papers was prolific, and the question was sometimes asked how he found time to do it all. He spent his short leaves in Ceylon at his cottage near Hakgala Gardens, taking with him his notes so that he might write undisturbed by official correspondence, and returning with new collec-

tions for further study. Much of his home leave was spent in herbaria in Paris, London and elsewhere comparing his Ceylon specimens with the original types. He always seemed to be at work, — or was he pursuing his hobby ? His interests never dimmed and papers for publication continued to flow from his pen till death intervened. Whatever he wrote, whether in official correspondence or for publication, was precise and clear, occasionally trenchant.

He was essentially a field man and always maintained that the proper place to study fungi was in their natural habitat and not in test-tubes. Of course he recognised the value of laboratory studies, but there was nothing he detested more than what he termed a 'test-tube species.' He was a keen observer and little missed his observation. It was once said of him that he wore spectacles not to enable him to see, but to ensure that he saw better than any one else.

The Tea Research Institute was fortunate in having Petch as its first Director. Though he held the post for but a few years his able advice and thorough knowledge of the Industry and its requirements were invaluable during its establishment and early years. He laid the excellent foundation on which others have built.

Petch was of a quiet, retiring disposition, hating publicity. He always preferred to work quietly and unobtrusively in the background. He was never very prominent in Committees, having little to say but that little was always to the point and full of sound advice. Although of a naturally reserved character those who knew him best will remember his kindly manner and droll humour.

C. H. GADD.

PROCEEDINGS OF THE 8TH CONFERENCE OF THE TEA RESEARCH INSTITUTE OF CEYLON

The Eighth Conference of the Institute was held on the 21st and 22nd January, 1949 in the Hall of Trinity College, Kandy, by kind permission of the Principal. The Chair was taken by the Chairman of the Tea Research Institute Board, Mr. R. C. Scott, C.B.E., while the Conference was honoured by the presence on the first day of His Excellency the Governor-General who formally opened the meeting. A full report of the proceedings follows :—

1st Day, Jany. 21, 2-30—4-30 p.m.

THE CHAIRMAN : Your Excellency, ladies and gentlemen, before proceeding with the business of the conference, it is my sad duty to allude to the passing on Christmas Eve, from heart failure, of Mr. T. Petch. Many of you will remember Mr. Petch as I do. He was Director of this Institute for three years in its very early days when it had its headquarters at Nuwara Eliya. I ask you to be upstanding and express our regret at his death and our sympathy with his relatives.

The conference passed a vote of condolence in the usual manner.

THE CHAIRMAN : Your Excellency, ladies and gentlemen, we are assembling here for the first time in Kandy for a Con-

ference of the Tea Research Institute. We have done this in the hope that this venue may perhaps be more convenient to members of the planting community who are resident in the mid-country areas of Ceylon and perhaps even to those who are resident in the low-country. I have no intention of taking up your time now, but I trust you will allow me to sum up the proceedings of the Conference tomorrow morning.

Your Excellency, we regard it as a great honour indeed that you have seen fit to be present with us on this occasion — (Applause). I now ask you to address the meeting at any length you choose and thereafter declare the Eighth Conference of the Tea Research Institute open. Ladies and gentlemen, I claim your attention for His Excellency.

H. E. THE GOVERNOR-GENERAL

HIS EXCELLENCY THE GOVERNOR-GENERAL: Mr. Chairman, ladies and gentlemen, when your Chairman very kindly asked me, as I was to be in Kandy at the time, if I would formally open this Conference, I said I would be delighted to do so on the understanding that I was not required to make any formal set speech. I will, therefore, relieve you of your anxiety at once by telling you I do not intend to do so. It does, however, give me very great pleasure to be here this afternoon, as much as a learner as any one else, but particularly because I appreciate, and I know you do, the importance of research to the Planting Industry.

The fact that both Government and yourselves are fully alive to its importance is shown, I think, by the recent amendments to the Tea Research Institute Ordidance, whereunder the L.C.P.A. now has rather greater weightage on the Board of the Institute and the cess has been increased from 14 cents to 25 cents for each hundred pounds of tea exported from Ceylon.

As a layman I have always been interested in tea. As you know I started my career in Ceylon, and I spent ten years of my official life in East Africa, the latter part as Governor, where I saw a good deal of the beginnings of the industry over there It is perhaps a good augury of the possible progress in East Africa, and at the same time a melancholy fact for us here in Ceylon, that I read that East Africa is busily engaged in trying to pick Ceylon's brains. Some of the distinguished officers of your Institute, I believe, are shortly going to leave Ceylon to teach East Africa how to grow tea.

The only other point I would like to make is this: it is obvious, as you know, that Ceylon has a great reputation as a country that produces teas of high quality. East Africa, virgin country as it is, has not achieved, and I do not think will ever achieve, that quality. In any case, you need not be worried too much because there is a tremendous internal market in East Africa if they would only care to exploit it. But what has given me some anxiety is the fact that, as I know, you are faced here with an increasing cost of production. I think I am right in saying that it is particularly in the areas that produce the highest quality teas that the question of cost of production looms very large. Therefore, anything that the Tea Research Institute can do by improved practice, both in field and factory, must be of vital importance to the Industry and will I believe be of very great value ultimately.

I will not keep you any longer except to say that I am looking forward to this discussion as much as any of you. I do

hope that the Tea Research Institute may flourish in the future as it has done in the past.—(Applause).

THE CHAIRMAN: I would like to thank His Excellency and emphasize the sense of honour we feel at his presence among this large audience which, it may interest you to know, numbers more than three hundred. With these few words I will ask the Director to open the proceedings by giving you his paper on the Work of the Institute.

THE WORK OF THE TEA RESEARCH INSTITUTE

ROLAND V. NORRIS, D.Sc., F.R.I.C.
DIRECTOR

I do not wish to take up too much of your time as we have a full programme in front of us, but it is customary for me on these occasions to review briefly a few of the more important problems which confront us and to give you some indication of possible future developments in the activities of the Institute.

There will probably be little doubt in the minds of those present, at any rate of those who work at elevations above about 2,000 feet, that the event which has caused most concern to the Industry was the sudden appearance in Ceylon of the Blister Blight disease of tea which occurred in October, 1946. With memories of the fate which overtook the Coffee Industry, there was wide-spread alarm that our tea might be faced with a similar disaster. But, however inconvenient and serious Blister Blight may be, this alarm was in reality based on a misapprehension. In contradistinction to the coffee leaf disease, Blister Blight does not attack mature leaf. Hence, assuming that reasonable precautions are taken, there is, therefore, little risk to tea in plucking of complete defoliation taking place resulting in a wide-spread death of bushes. With such bushes the most serious consequence of course is the loss of crop resulting from infection of the flush.

Ceylon was fortunate in that the disease did not appear until late in the year, only a short time before the climatic conditions prevailing in our dry season could take effect and check attacks. There was thus an interval before the next south west monsoon in which the position could be reviewed and steps taken to meet the threat. In fact, the subsequent monsoon in 1947 was very light in character, with frequent intervals of sunny weather. The incidence of Blister Blight was in consequence much less severe than most people expected and there was a tendency in some quarters to pass over from an unjustified permission to a rather exaggerated optimism about the disease. By this time the steps to be taken to counter the disease had been worked out and it was possible at the end of that year to bring into practice the recommendations which had been made in regard to pruning times and pruning methods. I am not going to deal with these methods which will be referred to by Dr. Gadd in his address to you this afternoon but simply wish to record that,

speaking generally, I think it may be claimed that the recommendations made have proved sound and have been successful in practice. It is necessary, however, to stress the principle underlying these recommendations about pruning which is actually very simple. Briefly it amounts to nothing more than this : In hot sunny weather the Blister Blight spores cannot survive for more than a very brief period of time and the risk of new infection is at a minimum ; recovery from pruning therefore should so far as possible take place while these conditions obtain. Climatic conditions vary so widely in Ceylon that it is impractical, and it would be undesirable, for us to attempt to lay down precise dates for pruning. You yourselves are in a much better position to decide. You know the time required under your conditions for your tea to come back from pruning and when reasonable spells of weather unfavourable to Blister Blight may be expected. These much be the determining factors in arranging your own pruning programme.

To pass on to tea in plucking, I should be interested to hear — perhaps rather later this morning when we are discussing Dr. Gadd's paper — what estimate some of those present would give of the loss of crop which has resulted from Blister Blight. In 1948, in the South west zones, we experienced for a change a normal monsoon, that is to say a period of cool, wet and sunless days extending over some three months. Conditions, therefore, were ideal for Blister Blight which was more in evidence then in 1947. But, as we are all aware, such conditions in themselves shut down flush production and lead to short cropping. It is difficult to separate these factors, and any estimate of Blister Blight loss must therefore be to a considerable extent a matter of opinion and of no particular accuracy. We should however like to have opinions on this point. It is a matter of experience again that where favourable weather, and here I am referring to weather favourable to the crop, follows on the decline of Blister Blight attacks, the bush, generally speaking, makes a remarkable quick recovery and rushes of crop frequently occur. How far do these mask the previous loss and what is their effect on the future behaviour of the bush ? It is at least significant that in the past year, when conditions for Blister Blight have been favourable, and fertilisers have remained in short supply, the export figure for Ceylon teas has reached a fresh record. Because I mention this please do not consider for a moment however that I wish you to take up the attitude that Blister Blight is not a pest of major importance. It is of such importance and will continue to demand our closest attention.

You have been frequently advised by the T.R.I. that the eradication of Blister Blight, for reasons which Dr. Gadd will put before you, is unlikely. But if we cannot eliminate the infecting spores, what other step is likely to be practicable ? Taking a long term point of view, the only alternative is gradually to replace our more susceptible teas with varieties which have been found to be resistant to the disease. Many such bushes have been found. I have no doubt at all that search on estates would disclose very many more. Vegetative propagation provides the means of rapidly multiplying such resistant material and, in my opinion, this approach is likely very quickly to assume greater and greater importance.

The question of tea selection and vegetative propagation will no doubt come up for discussion tomorrow and we should be

glad to receive information as to the degree of success which has attended the search for bushes resistant not only to Blister Blight but also perhaps to other pests such as eelworm or Phloem necrosis.

I will now pass on to another quite different subject. During the war years and while the whole of the Ceylon crop was taken on contract, there was little incentive to consider refinements of manufacture and it was, perhaps, inevitable that quantity came to be considered the governing factor. Mr. Horne will tomorrow suggest to us no doubt the effect this has had on our Ceylon teas and I think a good many people in this room can make a shrewd guess as to the view he is like to take. The Industry, however, is now rapidly beginning to realize that in the no distant future buyers are going to be in a much stronger position than they are at present. Tea production is increasing; the Netherlands East Indies will not remain indefinitely on their present low scale of production and the tea acreage in East Africa is expanding. What is going to be the result? I suppose we may consider two possibilities — one that there will be a marked fall in tea prices or alternatively that Ceylon by the inherent quality and character of its teas will still be able to command a premium for these. It would be nice to believe that the latter is correct but past history, such as the slump in the early 'thirties, does not provide a very encouraging basis perhaps for undue optimism. We know by experience that prices can fall very rapidly but that costs of labour and of production generally fall far more slowly. I do not feel qualified to express any opinion as to the levels at which selling prices and costs of production may be stabilised under the conditions which I have suggested may develop in a few years' time. It seems to me, however, to be a matter which might well receive more attention than appears to be the case at present.

This matter may appear to some of you to be somewhat outside my province but, in fact, it has an important bearing on the research policy of the Institute.

What contribution, if any, can the Institute perhaps make which may possibly help to bring down production costs. I think perhaps I may, at any rate, reasonably mention two subjects on which work is in fact already proceeding.

I have already referred to tea selection in relation to resistance to disease. But when this work was first begun before the war, that is before we had any reason to anticipate an invasion of Blister Blight, the chief object of the work was to discover planting matter of higher yielding capacity and capable of producing teas of at least equal quality. In agriculture generally, I do not need to remind you that in the case of almost every major crop immense improvements have been made by selection and genetical work which has enormously increased the value of the crop produced either by higher yields or by improvements in quality. For reasons into which I need not enter, seed selection in tea is not a practical proposition but the work already accomplished at St. Coombs by other methods has amply indicated that the general yield level of Ceylon teas could be very appreciably increased by the use of material obtained from bushes of tested high yield capacity and multiplied by methods of vegetative propagation. We do not perhaps particularly want to increase the overall crop of Ceylon tea, but if the same crop could be obtained from a smaller area of our better land, enabling us to abandon some of our more exposed

and eroded sites, usually situated on very steep land, and in consequence expensive to work, this would make a material contribution in reducing the cost of production. Such at any rate is the aim behind this work. This however is a line of work in which the co-operation of estates is very necessary. It is a commonplace with other crops that varieties that do excellently in one area often prove less suitable in other districts where conditions of soil and climate may be different. Moreover, it would be unwise for reasons which I have no time to develop at the moment, that planting material should be restricted to a single strain even supposing this were possible. As I shall indicate shortly we ourselves hope to extend this work to lower elevations and the more estates that take part the wider will be the basis of selection and the more chance there will be of finding bushes with the desirable combination of qualities for which we are seeking.

The other direction in which developments may assist in reducing the cost of production is tea manufacture, particularly perhaps in relation to rolling and withering. Much interest has already been aroused by developments in rolling methods and Mr. Lamb will be dealing with this question tomorrow. Elimination of withering, if possible, would of course constitute a notable advance in tea manufacture. A considerable amount of work has already been carried out by the Institute with this aim in view. It was perhaps unfortunate that, for causes outside our control, an undesirable degree of publicity was given in the Press and elsewhere to these preliminary experiments which have necessarily been so far of an exploratory nature. There is every indication that good liquoring teas can be produced, with a great saving in cost, by such methods ; the difficulty is to combine this with a more or less conventional appearance of the made tea. Many people may perhaps consider that too much stress is laid on appearance. For practical purposes however we have to face the fact that this character is demanded. It would, I must admit, be an understatement merely to say that the preliminary experiments made by the Institute using unwithered leaf were not received with enthusiasm by the Trade ! All the same, further consideration has, I think, led some of those who were most critical to modify their views to some extent as to the possibilities of such developments.

Be that as it may, experimental work of such a nature is, in my opinion, an essential duty of the Institute. We must not merely play safe but adopt a progressive and imaginative policy in regard to research and I can assure you, gentlemen, that in spite of earlier discouragements in these particular experiments, investigations on these lines are to continue.

I must now pass from these technical matters to say a few words about future developments of a more general nature.

When the Institute was founded, the research cess was fixed at 10 cents per 100 pounds of tea exported. This was increased to 14 cents in 1934 and has remained at this figure ever since. Naturally, however, the cost of running the Institute has increased very materially indeed and there are urgent demands for an extension of our activities. The salary scales of all grades of the staff have had to be substantially raised while, as you are all fully aware, costs of materials, buildings and so forth may be roughly taken as about three times those prevailing before the war. In these circumstances an increase in the cess was inevitable. The Board of the Institute has given this matter very close attention

and has reviewed in detail the Institute's requirements in the immediate future. The results of this enquiry showed that a cess of 25 cents per 100 pounds of tea exported was essential. A request that this increase should be brought into effect received, I am glad to say, the full support of the Ceylon Association in London, the Planters' Association of Ceylon and the Low-Country Products' Association. We are also indebted to the Hon'ble the Minister for Agriculture and Lands for the sympathetic consideration he gave to our case. An amending Ordinance was passed by Parliament in December and, with effect from the beginning of this month, the cess has been collected at the higher rate. I do not for a moment believe that you will consider a charge of a quarter-of-a-cent per pound as an excessive premium to pay for scientific research for the Industry.

In considering future expenditure, one major item to which the Board had already agreed in principle, concerns the setting up of a Sub-Station in the Low-Country. A very considerable sum of money has now been allocated for this purpose. The Sub-Station is likely to be located in the Kalutara area, and it is intended that this shall be under the charge of a member of the Senior Scientific Staff who will be responsible for experimental and advisory work generally in the Low-Country.

In preparation for this development we completed arrangements several months ago for the recruitment of a suitable senior officer and we congratulated ourselves when an officer particularly suited for this appointment, by virtue of his wide general experience of tea and personal qualities, accepted the post. This officer was expected to join the staff this month. With dismay, however, we received information only last month that he could not after all take up the post. We are therefore left with the very difficult task of finding another man. This is a very great disappointment and must inevitably cause some delay in implementing our plans.

Facilites for a training in research methods are shortly to be provided by the Institute for three research students, *i.e.*, for men already possessing a scientific degree, if suitable men can be found. Such training will be provided without any commitment on the part of the Institute that the men concerned will necessarily be absorbed on the T.R.I. Staff, though it is possible, so far as the near future is concerned, that there will be vacancies to be filled.

This brings me now to the question of staff which is causing us grave anxiety.

At the end of the war we lost two of our Senior Staff, Mr. King and Dr. Bond. The post held by the latter was filled by the appointment last year of Mr. Kemp. In July last year, however, Dr. Tubbs resigned to take up an appointment in England and, as you are no doubt aware, Dr. Eden is leaving us next week to organise tea research work in Kenya and Dr. Gadd retires at the end of March. The loss of these three officers with their long service and experience is of course a disaster of the first magnitude. They have all been outstanding in their respective spheres of work and their departure creates, as you will readily appreciate, a position of very great difficulty.

The Institute and the Tea Industry in general owe an immense debt to the three officers I have mentioned whose work has left an indelible mark on estate practice in Ceylon. The Chairman in his remarks tomorrow will no doubt be referring to their services but I cannot let

this opportunity pass without acknowledging my own personal obligation to them for their exceptionally loyal service to myself as Director. You will no doubt be interested to hear that Dr. Tubbs has settled down to an interesting and responsible post in the United Kingdom. Dr. Eden, whose last public appearance in Ceylon this will be, is about to apply the somewhat esoteric methods of his statistical approach to tea experimentation to the tea industry in Kenya ; while Dr. Gadd after a long and productive term of service in the East hopes, I thing, to sit back and relax, or at least to enjoy a change of occupation from laboratory to domestic chores.

All three officers and their families leave us with our very good wishes and we trust they will find happiness and satisfaction in their new spheres of activity.

Temporary arrangements had been made for assistance in the running of our Pathological Division after Dr. Gadd's departure. These unfortunately have now proved fruitless as we have just heard with great regret of the death just before Christmas of the officer concerned.

On the other hand we have been fortunate in securing a highly qualified officer to succeed Dr. Tubbs. Mr. Portsmouth arrived in Ceylon on Monday and is with us here today when I hope he will have the opportunity of becoming known to many of you.

You will appreciate, gentlemen, that the position I have described is going to make things very difficult in the immediate future. The advisory work of the Institute continues to increase by leaps and bounds and in dealing with this and cognate matters I shall for sometime need your patience and forbearance which I am confident I shall receive in full measure.

In conclusion, I must add a few words on another matter which, though not in one way a direct responsibility of the Institute as such, continues to occupy much of my personal attention. I refer to fertiliser rationing. I certainly did not anticipate in 1942 when I was asked to organize fertiliser rationing in Ceylon that this would continue for several years after the war. It is disappointing that the question of nitrogen supplies is still so difficult. Every effort has been made, and will continue to be made, to secure a larger allocation for Ceylon and in this connection I must acknowledge the assistance I receive from the Controller of Imports and the Ceylon Government. I am glad to say there is now a prospect of a small increase in Ceylon's nitrogen quota for the present year but the future prospects are still very obscure. In this connection I should say that though we receive considerably less nitrogen than we would wish, Ceylon has been treated not ungenerously, In fact, apart from India, Ceylon has been receiving a bigger percentage of the ammonium sulphate available for export from the United Kingdom than any other country.

As regards phosphoric acid, no difficulty is anticipated. Potash supplies have, however, been temporarily cut off owing to the disturbed conditions in Palestine but supplies of a rather lower grade are beginning to come forward from Europe.

The nitrogen coming forward is not all in the form of ammonium sulphate. This fact, together with the different grade of potash just referred to, will necessarily involve some alteration in the bulk and composition of the mixtures issued. I know this causes some confusion but in the circumstances it is unavoidable. I think such confusion will be reduced if you remember, taking the tea mixture as an example,

whether the mixture is a 370 lb. mixture of a 430 lb. or any other figure, the amount of nitrogen remains the same. In the bulkier mixtures this simply means a rather larger application is required.

Some people again are under the impression that when, for example, a 370 lb. mixture is issued, this means that the rate of application to be made is 370 lb. per acre. This is quite a mistake. The actual allocation of nitrogen per acre is of course the figure shown in your fertiliser permit.

I trust the rationing scheme has been of some use in securing an equitable division of such manurial supplies as have been available. I will only add that such success as has been achieved is in a very large measure due to the very fine co-operation we have received from the Fertiliser Firms and, as regards distribution, I must also extend my very cordial thanks to all those who have so kindly assisted me by acting as District or Station Organisers.

THE CHAIRMAN: I am not for the moment going to invite any questions on the paper that has just been read by Dr. Norris for the reason that most of the technical points to which he referred will receive further mention in the later papers and can be discussed then.

I will now ask Dr. Gadd to address the Meeting.

NUTRITION IN RELATION TO DISEASE

G. H. GADD D.Sc.

PATHOLOGIST

At our First Conference held at Peradeniya 20 years ago I spoke on the relationship between food reserves and disease in the tea bush. Today, probably the last occasion on which I shall have the honour of addressing you, I want to revert to the same subject and to show its bearing on present-day problems.

First, I must remind you what the food of a tea plant is. It is not the stuff you get out of manure bags, but something quite different. You can see it best as the kernel of a tea seed. It consists of carbohydrates, protein and oil. All seeds contain similar foods to give the young plants a start in life; later they are able to make the food for themselves from materials obtained from the air and soil. Although green plants only can make these foods from simple materials they are required by all living things, both animal and plant. All animals and non-green plants are dependent, either directly or indirectly, on green plants for their food and consequently for their existence. The struggle for existence is largely a food hunt, and much of what we call disease is merely a result of that food hunt.

The struggle amongst green plants is not for the elaborated food but for conditions which will permit them to make it. Their requirements are (1) the raw materials and (2) the power or energy for the processes. The necessary energy is obtained from the sun as light — so green plants must have a place in the sun. The

raw materials are obtained from the air and the soil. Some of them are supplied to crops as manures which are often mistakenly thought to be the kind of food plants require. Of the crop harvested, 40 per cent. of it comes directly from the air, 50 per cent. is derived from water, leaving only 10 per cent. as nutrients derived from the soil and the manure bag.

But neither the energy nor the mineral nutrients are of any use unless the plant has well-equipped factories in which to carry out the complicated processes. These factories are leaves. Without leaves, a tea bush can no more manufacture food than an animal can, no matter how much raw material and power are available. Leafless, it still requires food to maintain life, and considerable quantities of it to build new factories in which to resume manufacture. Unless the leafless bush has food in reserve for such an emergency it has no chance of survival. When a bush has a full canopy of foliage the presence or absence of a food reserve is of no immediate importance.

The food when made is either used immediately for further growth, *i.e.*, for the development of more leaves, or it is stored for later use. Some bushes are inherently more thrifty than others and so put more food into reserve. Climate also has a marked effect on the amount of food stored in a tea bush. Up-country bushes store more than those grown in the low-country, and for that reason, deaths after pruning occur most frequently at low elevations. Such deaths can be avoided if the bushes are pruned in such a way that they are not denuded of leaves. That is the 20-year-old story, but it is sometimes forgotten.

The tea industry is fortunate that few animals, other than men, and few non-green plants have any great liking for tea leaves. That is not because our tea bushes are superbly healthy ; it is just that tea apparently is not a popular item in the food hunt But there is one non-green plant which has an extraordinary liking for it. So great is its liking that so far as we can ascertain it will feed no nothing else. I refer to the fungus *Exobasidium vexans*, the cause of Blister Blight. That fungus lives on tea leaves, but I see no reason to believe that it will feed only on leaves of undernourished bushes, nor can I believe that the majority of bushes in Ceylon suddenly became debilitated in 1946. The simpler and truer explanation of the virulence of the disease is that the tea bush is the natural food plant of *Exobasidium*. Consequently it connot be controlled by more manure or different manure or any other such-like simple way.

The most destructive form of plant disease, as Ceylon knows to her cost, is one which attacks and destroys leaves. So it was not surprising that the advent of Blister Blight created considerable alarm.

Experience during the last two years has allayed many fears, and has shown that the extent of the damage caused by Blister Blight depends largely upon the manner in which the bushes are treated agriculturally.

The usual method of protecting plants against fungus leaf diseases is by coating them with a thin layer of poison to kill the invading parasites before they can do any harm. That treatment is protective, not curative, and must be carried out just as soon as weather conditions begin to favour the parasite. The poison is applied either as a watery spray or as a dust. Dusts are as a rule less efficient than

sprays against fungi. Sprays are used in nurseries with good results but their general use in tea fields is debarred for well-known reasons. Even if those difficulties and objections could be overcome, it is doubtful that spraying would ever be an economic form of control of Blister Blight because of the frequency at which spraying would have to be done. Control measures must, therefore, be based on principles derived from a knowledge of the fungus and the bush.

One of the most important characters of *Exobasidium vexans,* the Blister Blight fungus, is its inability to invade and feed upon fully grown leaves. For this reason the fungus, by itself, is unlikely ever to kill a tea bush, unless climatic conditions favour the fungus all the year round, If tea bushes were grown for their fruits and not their young leaves, Blister Blight would probably not be regarded as a disease of major importance. It is because the bushes have to be plucked and stimulated to produce abnormal amounts of young leaf, that Blister Blight finds our tea fields such a fine place for its food hunt. Logically the best way to control Blister Blight is to stop plucking. Although that is not practicable it should direct attention to the importance of plucking in the control of the disease.

The importance of the leaf in the tea bush's economy was certainly recognised by the planters who devised the formula "Two leaves and a bud for the market and one full leaf and the fish leaf for the bush." That formula proved to be an excellent working rule before the advent of Blister Blight and it still forms the standard for Ceylon plucking. If bushes are plucked to a lower standard, it is usually on somebody else's estate. Now that Blister Blight is in the field as a raider we may ask "Whose share of the spoils does it take ? The market's or the bush's?" As the fungus attacks young leaf only it may appear the market's share is the one to be raided. But before that answer is accepted it would be well to look further into the question and see how the fungus operates.

When white blisters are very numerous in the fields. the air contains a gigantic number of spores as microscopic dust which is slowly deposited on everything. Each blister liberates about a million spores per day, but fortunately they do not all fall on tea bushes. Where the spores lodge they stick. It is also fortunate that the spores which fall on a tea bush do not all germinate as they are relatively short lived and a few hours' direct sunshine kills them. They survive best in cold sunless weather and they begin to grow when wetted by dew, mist and rain. At one time it was thought that the young fungus entered the leaves through the breathing pores (stomata), but it is now known that it makes a forcible entry through the cuticle and cell walls. The fungus, however, is unable to force its way into all leaves, even of the tea bush. Our experiments show that, normally, the leaf enveloping the bud and the first from the bud can be infected quite easily, but as the leaf ages, it becomes increasingly difficult to infect. As a rule, the third leaf from the bud cannot be infected. Of course blisters are often seen on third and even older leaves but it must be remembered that a white blister takes about three weeks to develop.

Now let us assume that conditions are favourable for heavy blister attack and that all leaves are being infected as they unfold from the bud. For about a week the unfolding leaf shows no visible sign that it has been infected. During that time the shoot has elongated and another leaf

is unfolding. Our first infected leaf has now become the second from the bud and is perhaps showing some translucent spots but no sign of blister proper. About three weeks after the start of the attack our first infected leaf is carrying white blisters, but by that time it has probably become the third leaf from the bud. At this stage the plucker arrives, and takes two leaves and a bud leaving the third well-blistered leaf as the bush's share. That leaf is probably of no more use to the bush than it is to the tea maker.

If you have followed me this far you many well ask "Why should the shoot be allowed to grow until the infested leaves develop blisters"? It seems more reasonable to take the leaves to the factory before they become unsuitable for manufacture and to leave nothing for the bush. This is the basis of the Institute's recommendation to pluck at short intervals and to pluck close during periods of severe infection. Only the young growth above the plucking table should be harvested. The plucker's hands should not enter the bush nor should young growth be taken from the sides of the bush below the plucking table. This apparently severe form of plucking can do no harm so long as it is confined solely to the times when weather conditions favour the disease and when all young leaf is consequently being infected.

When weather conditions improve and the severity of blight dies down, it must not be forgotten that the bush received no share of the leaf produced during the attack. That should be made good. A period of close plucking should be followed by a period of light plucking with the definite object of increasing the bushes' permanent foliage. This perhaps is the most difficult to carry out, because the improvement in the weather conditions stimulates the bush to more rapid growth and young leaf appears abundantly on the bush. That is a god-sent opportunity to make good any shortfall of crop. That temptation should be resisted until the bushes carry a good canopy of leaves.

What I am advocating can be summed up in the words "Bush Management" and that means rather more than the adherence to certain rules formulated by some one else. It requires personal judgment and a knowledge of certain fundamental principles.

The importance of permanent foliage to a bush cannot be exaggerated. Without sufficient foliage the bush is starving, no matter how much manure is applied or how much crop harvested. During the war, crop production was of paramount importance for patriotic motives. Large crops were obtained, though manures obtainable were at a minimum. Unfortunately those high yields are now accepted as standards, to be achieved regularly. A bush can produce only a certain amount of young leaf and if too much is sent to market and too little left for the bush, the bush must deteriorate. It is not an uncommon sight to see bushes regularly plucked although the foliage can only be described as scanty. Such bushes are often the most severely plucked and have little opportunity of forming a good cover of leaves or of building up a reserve of food. Successive prunings result in complete exhaustion of what reserves the bushes may have. For this reason deaths after pruning are becoming far more common amongst up-country bushes than formerly.

The remedy for poor foliage is rest. Pruning will not help nor will extra manure until the bushes carry enough leaves to use it. If the bushes still fail to carry their leaf, a cause other than Blister Blight must be sought.

In conclusion, I would like to say a few words about the premature blackening of blisters. It is due to the activities of other fungi, the most prevalent of which is one known as *Collectotrichum camelliae* the Brown Blight fungus. *Colletotrichum*, fortunately is a very weak parasite. It is quite incapable of invading a healthy leaf. But when the leaf cells are damaged, as by the sun causing a scorch, the fungus immediately gains entry and kills the damaged cells. Most of what is called Brown Blight results from sun scorch or similar injury.

Exobasidium, the Blister Blight fungus, has very different characters. It is able to invade a healthy leaf but it cannot feed on dead cells. Its own life, therefore, depends upon the host cells remaining alive. Although it gets its food from leaf cells it does not kill them until its life cycle is almost completed. Then in order to produce millions of spores each containing a small amount of food, it takes everything it can from the invaded cells. This exhausts them and causes their death. The dying and dead cells can be recognised by their dark colour and these normally are to be seen after a blister has been white and sporing for some days.

When a leaf is invaded by Blister Blight the invaded cells are weakened and they lose their ability to resist entry by several other fungi, including *Colleotrichum* the Brown Blight fungus. So if these spores fall on the part of a leaf weakened by Blister Blight they are able to enter after germination. These secondary fungi cause the death of the invaded leaf cells almost immediately and they then live on the dead issue. This proves fatal to Blister Blight as it cannot get its food from dead cells.

The effect of this secondary invasion is to be seen on most bushes. The blisters blacken before they become white which means that the Blister Blight fungus is killed before producing spores. The secondary invasion may occur at any stage in the development of the blister and its value is greatest when it occurs early before *Exobasidium* has begun to spore. Its effect is to reduce spore production and thereby reduce the incidence of Blister Blight.

These secondary fungi will not eradicate Blister Blight; at best they reduce its incidence. Also they may not prove an unmixed blessing for the following reason.

You will note the *Colletotrichum* and the other secondary fungi are not parasitic on the Blister Blight fungus. They follow that fungus into a leaf and then rob it of its food. They are, therefore, parasitic on the leaves and there is a risk that they may invade a greater area than Blister Blight does. So far we have not found that to occur on leaves, but there is ground for suspicion that it sometimes occurs on young stems.

On the whole I think these secondary invaders must be regarded as beneficial at present, but it is very improbable that they will materially reduce the importance of Blister Blight as a pest of tea.

Blister Blight gets its food one way and Brown Blight another. But they both get it from the tea bush. We cannot stop that food hunt but we can by proper bush management ensure that the bushes are not placed at a great disadvantage.

DISCUSSION

THE CHAIRMAN on inviting discussion intimated that questions on any pathological subject not touched upon in the paper could be raised.

Mr. Kenneth Morford said that Dr. Gadd's address was one of the best lectures on plucking they had listened to, and they would be in complete agreement with what had been said. He asked if any advice could be given on the subject of stem infections. Should infected shoots be broken back, and was there any prospect of damaged shoots, putting out new leaves?

Dr. Gadd said that he had made little or no reference to stem infections in his paper. Blister Blight attacked young stem tissue in exactly the same way that it damaged young leaves. The Blight normally killed the stem in the region of the attack and so caused the death of the entire shoot above it, but it caused no injury to the buds below the damaged part of the stem. Those buds normally would break later and give rise to new shoots. The attacked shoots should, therefore, be broken off just below the damaged area.

During periods very favourable to the disease, such as occurred in Dimbula during the last South West Monsoon, another type of stem injury occurred. Young shoots below the plucking table, inside the bush, were blackened right down to the base. When he first saw them he was somewhat alarmed as such damage was likely to affect future crop. Later he was agreeably surprised to hear that the bushes were flushing well. Those blackened young shoots were of no interest to the pluckers as they carried no flush. He was of the opinion that such blackened shoots should be left alone to avoid injury to any surviving buds at the base of the shoots.

Dr. Gadd also commented on the difficulty of making generalisations regarding the treatment of bushes under such varying conditions. The more he saw of the disease the more he realised the effect of local conditions on its severity. He illustrated his point by referring to pruning. He said that on St. Coombs a few bushes had been pruned each month to ascertain the effect of Blister Blight during recovery. The bushes pruned in February last year were almost leafless in August owing to severe attacks. The conclusion to be drawn was that February was a really bad month to prune in. Yet in August he saw fields in Dolosbage with an excellent cover of foliage and being plucked though they also had been pruned in February. He considered local knowledge to be of the utmost importance, not merely a knowledge of a district but of individual fields. Some fields appeared to suffer more than others under what appeared to be very similar conditions, and no satisfactory reason could be given for it. He thought that superintendents with their experience of individual fields and knowledge of local climate would have little difficulty in applying the principles given by the Institute. In cases of difficulty the Institute would always be willing to help.

Mr. H. C. Cosens said that on some estates up-country there had been a wholesale cutting out of high shade to meet the Blister Blight menace. He asked whether Dr. Gadd agreed with the soundness of that action.

Dr. Gadd replied that there appeared to be some misunderstanding regarding the importance of shade in the control of Blister Blight. It was perfectly true that the disease became prominent earlier and persisted longer in well shaded places. But when climatic conditions were favourable to the disease, *i.e.*, when there was little or no sun and the bushes were continuously wet, unshaded areas were as severely attacked as shaded areas. The effect of shade was seen best when the disease was

relatively of minor importance. Blisters could then be found in the shaded areas when the rest of the tea was free. That was because direct sunshine killed the spores and helped to dry the dew off quickly. The Institute had advocated the control of shade but not the complete removal of it. By control was meant the removal of excess shade by lopping to allow sunshine, when there was sunshine, to reach the bushes. He felt sure that the removal of all shade from tea would not reduce the incidence of the disease materially. So, regarding the cutting out of shade purely as a means of disease control he was dead against it.

Mr. Alban Wijesekera asked whether the Institute advocated ring-barking of trees before felling. He had seen Grevilleas felled on many estates without being ring-barked, and wondered which was the correct method.

Dr. Gadd said that the question of right or wrong did not arise. If one wanted to get rid of a tree it had to be felled. There was nothing fundamentally wrong in felling living trees. But it was well known that when trees, particularly Grevilleas, were felled in tea, some bushes in their immediate vicinity were likely to die of Ustulina or Brown Root diseases. These diseases were almost invariably associated with the presence of tree stumps. He had written an article in the Tea Quarterly a few years ago, advancing the idea that ring-barking might be a means of diminishing the risk of root disease following felling.

When a living tree was felled its roots remained alive for some time and could not be invaded by saprophytic fungi in the soil. Spores of certain parasitic fungi that happened to fall on the cut surface germinated and rapidly invaded the stump and roots without opposition. The fungi later passed to living tea roots in contact with the stump's roots. But when a tree was ring-barked the roots died first and the branches later. As soon as the roots were dead numerous saprophytic soil-inhabiting fungi invaded them and established themselves there. Then when the tree was felled and spores of parasitic fungi germinated on the cut surface, the parasites encountered strong resistance from the saprophytes already established there. In that competition for food the parasites were usually defeated and could not establish themselves in the roots. The risk of their passing to tea was thereby diminished.

The object of ring-barking was to kill the roots by starvation before felling, in order to diminish the risk of later occurence of root disease in the surrounding tea. Where root disease normally occurred after felling, ring-barking was well worth trial.

Mr. F. A. Bourke said that a lot of poor and debilitated tea was to be seen as individual bushes and as small areas. He asked whether Dr. Gadd considered that to be due to Blister Blight as it seemed to him that such symptoms were more common than they had been twelve months ago.

Dr. Gadd replied that Blister Blight was accused of being the cause of more ills than it was really responsible for. There had been weak bushes in Ceylon before Blister Blight arrived. Blister Blight tended to show up such bushes, and as more attention was paid to the condition of foliage more weak bushes were being noticed.

The usual symptom of the debilitated tea bushes was an inability to retain their leaves. The bushes had poor foliage and thin wood. Those symptoms could be

caused by a number of different agencies. For instance, anything which destroyed the feeding roots or prevented their free formation would cause the symptoms. The amount of water a bush could absorb depended upon the number of its feeding roots; and there was a balance between the number of leaves it could carry and the amount of water it received. One of the worst destroyers of feeding roots was the meadow eelworm, *Pratylenchus* (*Anguillulina*) *pratensis*. That parasite was known before the advent of Blister Blight. It was the cause of the poor condition of many bushes, but not of all of them.

The history of many poor bushes sent to the laboratories could be read from their frames. They had a few whippy shoots and very few leaves. But away back in the past they had been pruned with a saw; the large saw cuts were very obvious. The wood formed since then had progressively become worse after each pruning. He suspected that deterioration had begun when the bushes were hard pruned. The saw had been used on the 'kill or cure' principle. The bushes were neither killed nor cured. Blister Blight could hardly be held responsible for their condition now.

(Dr. Gadd has added the following statement to his reply. Blister Blight is doing the greatest damage in areas frequently subjected to mist. There is evidence from such areas that the bushes have hardly added a single leaf to their permanent foliage since the arrival of Blister Blight because of the great frequency of mists. Blister Blight may not be the sole cause of the damage but it is the primary agent. Leaves which were fully developed when the disease arrived are now falling off as a result of their age. The bushes appear thin because there have been no leaf replacements. This type of debility is restricted to those fields covered by mist on most days of the year).

The Chairman then asked if any one present was in a position to answer the question put by the Director as to the loss of crop produced by Blister Blight.

Mr. Wacey referred to the difficulty in separating the Blister Blight effect from other factors such as weather conditions and cultivation.

Dr. Norris said he had stressed this difficulty in his paper and had referred to it because one heard various estimates of loss of crop put forward which he felt had very little real foundation.

Mr. G. K. Newton thought information on the question could be gained by a study, not perhaps of single year records, but of pruning cycle records. These should give some indication of a decline in yield. He had studied a number of such records himself and could now and again discover indications, not only on individual estates but on individual fields, where it appeared that Blister Blight was responsible for the falling off in yield.

Mr. Morford said he would like to support Mr. Newton very strongly on that point. One of the best guides in this connection was the records superintendents were asked to keep by the Tea Research Institute. A comparison of the falling off in crop where there was a bad attack in a field against the field records where there was no attack should give some indication of the effect of the disease. In spite of record yields in Dimbula in the past year, there were clear indications of the loss in attacked fields.

Mr. Sydney Smith said he thought there would be considerable unanimity in regard to loss of crop but it would take a considerable time to obtain a direct answer

to Dr. Norris's question. There were other factors which compensated for Blister Blight losses. Such losses varied from field to field and district to district down to practically nothing in the low-country. Changes in cultivation programmes and differences in plucking also complicated the picture. Dr. Gadd's lecture on nutrition had been most valuable. He would, however, ask if the time had not come for a general survey into the causes of the deterioration of certain tea areas. Very little had been said about the meadow eelworm but his impression was that this was on the increase, particularly up-country. Other factors also were concerned and he thought a general survey such as he suggested would be helpful.

THE CHAIRMAN then called on Dr. Eden to give his paper.

YIELD IN RELATION TO BUSH GROWTH

BY T. EDEN, D.Sc.,

AGRICULTURAL CHEMIST

There is a very general impression that all is not well with the appearance of a great deal of tea in Ceylon, particularly in up-country districts. Bushes, it is said, look thin and played out and the number of such enfeebled specimens appears to be increasing. Intimations of this general unease reach the Tea Research Institute in several forms, three of which are of quite regular occurrence. It is sometimes suggested that after seventy or eighty years of tea cultivation on the same soils, there may be deficiencies in the so-called trace elements, and that the general debility of tea is due to the virtual exhaustion of the soil of these elements by reason of erosion and the constant drain on reserves. A second attempted explanation is that the bushes are suffering from the restrictions in manuring that have been imposed during the last six or seven years of rationing. Thirdly, there is increased talk attributing defoliation to Blister Blight. I do not myself think that any of these hypotheses, singly or in combination, can satisfactorily account for the quite evident deterioration that is remarked, and in order to clear the way for what I have to say later, I had better quite briefly say why.

The suspicion that trace element deficiencies are responsible is a not unnatural one, but at present there are two difficulties about it. Such deficiencies are generally accompanied by very striking symptoms in the bush other than an unthrifty condition. Tea yellows due to a sulphur deficiency for instance is, according to published accounts, quite unmistakable. Moreover, deficiencies are primarily due to peculiarities of geological constitution in the rocks from which soils are derived, and are in actual experience observed over much larger areas, even in the first stages, than are noticeable here. As regards Blister Blight, Dr. Gadd has indicated that the older leaves of the bush are not susceptible to the fungus, and the weakness in foliage density which a bad attack of blight reveals is, as far as observation goes, a weakness which quite definitely antidates

the disease. The disease in other words merely reveals the nakedness of the land. The third explanation does not satisfy me either, except to the extent that during the war we have been producing crops of the same order as before the war on very much less manure. Without a shadow of doubt there has been a great deal of hard plucking in order to achieve this result.

Two of these proferred explanations assume that the conditions can be rectified by putting something into the ground. My own conviction is that, without in the least minimizing the importance of adequate nutrition, the present state of affairs is the natural consequence of harder pruning and plucking that, according to my observations, has becomes general in the last decade. Dr. Gadd has spoken about the importance of the leaf as the manufactory of the food of the bushes. He has quoted figures to remind you of how little of the tissues of the bush is composed of those elements that are derived from the soil. From my rather different standpoint I want to emphasize the same points : that what is taken off the bush as crop is intimately related to what is left on as foliage. Obviously, if crop is not taken, the foliage category benefits and vice versa. It is necessary that a balance should be struck between the two. It is salutary that this concern for the appearance of the bush should be widespread for, in my opinion, it is long overdue. In what follows I am going to draw attention to a few of the pointers from the experiments of the Institute which show the particular importance of considering the bush as a whole when cropping capacity is under discussion. If I may make a personal assessment of the permanent contribution made by the experiments it has been my privilege to carry out here, it is not that the experiments have shown that this or that manure is more or less beneficial : it is the insight such experiments have given into the essential oneness of the bush is all its aspects.

First of all then, what evidence is there of the kind of balance that is presumed to exist between the foliage-leaf cover and the harvested crop ? I do not wish to put more weight on purely empiric data than they will support, but my justification for quoting what data we have is that it is better than none at all, and I think that it may serve to emphasize the point I wish to make. We have followed during four cycles at St. Coombs the relationship between crop, foliage and pruning wood. We have also made sample estimates of the crop-foliage correlation on five other estates in widely different districts and climates, and with pruning cycles from 2 to 5 years. It is relevant to remark that these data were compiled under the normally accepted conditions of plucking carefully to a full-leaf. If we take the total of crop plus foliage leaf and express the foliage leaf as a percentage of this we find that the lowest values observed in the series was 46 per cent, and the average of all data was 54 per cent. If single leaf plucking represents a desirable norm, then we shall not be far out if we say that to maintain that norm at least as much leaf must remain on the bush at the time of pruning as has been garnered in crop. When therefore we see the ghostly appearance of many bushes at the end of the cycle, we may well assume that they have contributed little to the yield per acre unless they have been ruthlessly plucked. If they have, then the proportion of leaf to crop will have fallen. We have data to show that by fish-leaf plucking the proportions can be altered from 50 leaf to 50 crop, to 20 leaf and 80 crop. But by doing so the pruning wood

has been diminished by half and the total growth of crop, foliage and wood by one third. This decrease in total growth has been effected without any change in manure, so it is unlikely that further manuring will provide the remedy, and extremely likely that if the mutilation of the bush continues, the crop will suffer.

That brings me to the second pointer which has to do with the immediate effect of manuring on crop. There is a very persistent belief that it is possible to force crop with manure to the ultimate detriment of the bush. Correspondents with the Institute write of the lasting effect of certain manures and the flash-in-the-pan effects of others. If there is one thing of which I am certain after my 21 years connection with tea, it is that the results of an individual application of manure cannot be assessed, either in the field, or in the crop book, on a short term basis: there are too many variable factors at play. The experimental results of the Institute's manurial trials show with remarkable consistency that if you secure an increase of crop as a result of increased manurial application, then you increase the foliage leaves too to a corresponding degree. It would indeed be strange if it were otherwise. The plant is an organism whose growth processes are integrated one with another. I am not very fond of anthropomorphic analogies; they are usually wrong when applied to plants. But nobody I think would suggest that by increasing a growing child's rations, its fingers could be induced to grow whilst its arms remained the same length.

I have quite often emphasized the fact that nitrogen is more effectively used in the later part of a cycle than earlier on and I have attributed this to the greater size of the bush with its enhanced foliage and root system. If this contention is correct, then such an effect should not be confined to response to nitrogen. It should be common to phosphoric acid and potash. The response to the latter nutrient has only recently begun to show, but an examination of twelve years responses to nitrogen and phosphoric acid shows that the proportionality between them over the whole range of years and cycles is unmistakable. The validity of the original hypothesis is accordingly strengthened. Manurial response is greater the better the bush is provided with roots and foliage wherewith to garner and synthesize the nutrients applied in the manure.

My purpose so far has been to try to change the emphasis which I feel has been far too common in the past, and I propose now to consider the question of defoliation from a different angle in the light of some recent experimental work on St. Coombs. But first let me say that the effective life of a leaf is not indefinite, even with an evergreen. Leaves are continually falling off, severed from their stalks by perfectly natural processes when their work is done. Naturally the older leaves and those which by reason of position and consequent competition for light are least effective, fall first. This really involves to some extent a distinction without a difference. It should be obvious that if the leaf is given a chance to remain longer on the bush because a longer cycle is being run: if also the lower leaves are on the same account being heavily shaded, then the lower branches of bushes running long cycle cannot be as thickly clad as those running shorter periods other things, e.g., the balance between foliage and flash, being equal.

I have already said that you cannot alter that balance by manuring. How can it then be altered? The answer is by resting. In the last week of October two

areas of tea were pruned on St. Coombs. They were cut-across at 18 inches from the ground preparatory to having the thinner twigs cleaned cut. One of these areas had been plucked for two years and then cut-across at 15 inches and allowed to rest for 10 months. The differences in appearance between the two has been remarkable. The unrested tea was devoid of foliage below the running level ; an eighteen inch cut-across was actually a clean prune. Recovery from pruning has been quite normal but it is not yet ready for tipping after 82 days. The rested area retained a good canopy of foliage after pruning. From the distance the only difference noticeable between that area and the surrounding tea was colour, the pruned tea appearing darker. A certain amount of that residual leaf suffered from scorch later but a good deal remained intact. The effect of the rest has been to maintain and encourage the foliage growth on the bush and to speed up recovery, for the area was ready for tipping in 74 days and is now in production again.

On the consideration of the physiological aspects of this result I am not going to embark.There is no time to do it, and little knowledge relevant to the crop on which to base such consideration. But this fact remains, even though the explanation in detail has to be waived, that Blister Blight or no Blister Blight, the antidote to thin bushes, and the alleged defoliation, is to treat the bushes reasonably and, when in doubt rest them. It is no use resting for a few weeks or a few months only. Circumstances alter cases but at St. Coombs nothing less than 9-12 months seems to safeguard the foliage cover. A three year field on St. Coombs was rested without any preliminary cut-across late in July and has just been pruned. There is no canopy of foliage left: the lower leaves had disappeared before resting was started. Nor is resting beyond a twelve month period at a stretch any great advantage. Two areas were put under experiment, one to rest for a year, and one for two years. The purpose was to bring two prospective halves of a single experiment into the same pruning cycle. The area rested for two years had the centre cut out at 18 inches half way through the two year period. The difference in results does not appear to have justified the longer period.

Finally, I propose for serious consideration a system of periodic rejuvenation. It might have been done during the period of tea restriction, but although some areas of tea were rested, they were abandoned rather than rested and the benefit was neither properly distributed nor reaped to the best advantage. I suggest that for tea on a three-year cycle three periods be run after which the tea shall be pruned and rested for a year. It seems to me that the loss of yield from 10 per cent. of the acreage will be more than offset by the enhanced productivity of the balance of the acreage.

After twenty years spent in exploring the possibilities of manuring tea, my parting motto to you is 'look after the bush and the manures will look after themselves.'

Mr. R. L. Mc Connell said that twenty or twenty five years ago it was common usage to lop and fork in the prunings at the time of pruning. That was done less frequently now and he asked if there were any reasons for or against the practice.

Dr. Eden said he thought the main objection some people had to the forking in of prunings direct was the fear that this might cause root disease. Later it became recognised that, except possibly for Rosel-

linia, the risk was a small one and it became fashionable to recommend forking in the prunings. The only advantage he could see for the forking in of prunings direct was that by this method more material was incorporated in the soil. There was a general fear that if the leaf from prunings were allowed to drop off, or were beaten off after drying, some essential nutriment might be lost in the process. That was not the case. If the leaf was left to fall off and rot on the ground loss of nutrients would occur, but if the leaf were forked in immediately it was detached from the pruning sticks, there was no loss at all.

He regarded the question as to whether one should fork in prunings direct or merely fork in the dried leaf to be one merely of cost and convenience.

Mr. Mc Connell asked if there were not another aspect of the question — soil aeration.

Dr. Eden thought it was difficult to say whether soil aeration produced by the incorporation of whole prunings was superior to that obtained from leaf fall only. He said the practice of cultivation with the fork, or in temperate agriculture with the plough or harrow, appeared to him to be one of trying to crack a Barcelona nut with a sledge hammer. Soil aeration sufficient for the plant could be secured if the rainfall were made to percolate through the soil instead of running off this. The air referred to in soil aeration was not so much air in the pores of the soil as air dissolved in the soil water. Provided the normal rainfall was being passed though the soil by a process of easy percolation, then it should not be necessary to fork or disturb the soil with a cultivation instrument to anything like the extent that was commonly practised. The use of cultivation — and of course it was useful—depended on factors other than soil aeration and he did not himself think he would expect improvement in soil aeration from whole prunings in comparison with pruned leaf only.

Mr. F. A. Bourke asked how Dr. Eden regarded the practice of burying prunings in pits as distinct from forking them in.

In reply Dr. Eden said he had been trying the burying not only of prunings but of weeds and other similar materials in pits and he was all in favour of this practice if it were done properly. He did not consider that the root damage caused by the digging of pits was excessive. Some damage there must be but if, after the pits were dug, these were filled with green manures or organic debris of that sort, then there was something into which the roots of adjoining bushes could easily penetrate. The increased penetration of the roots and the good nutrition thus secured would, in his opinion, more than compensate for any root damage.

He would link the question with the previous one. He had already said that the main purpose of cultivation was for something other than aeration though aeration played a part. He would amplify this by saying that an important aspect of cultivation in tea was to give living space for the roots. Tea had had a very weakly penetrating root system. Anything in the nature of an unkind soil was fatal to tea. By a system of using green manures in pits penetration was assisted and the roots often got below the gravel pan, especially in patna soils. For these reasons he was in favour of the practice.

The Chairman asked whether tea in general in Ceylon could not receive considerable re-invigoration by a more inten-

sive process of growing and burying green manures than was at present being done on estates.

Dr. Eden said his answer to that would be partly yes, and partly no. Very intensive green manuring, if carried to excess, could actually reduce crop but he was unable to say when the critical line between sufficient and excess green manuring should be drawn. When there was excess a surprising increase in crop was obtained when the time came to cut out the green manure. But obviously the aim should be to produce green manures up to that limit. That limit would have to be determined by rule-of-thumb methods by every superintendent for himself.

With that reservation, he would say yes to Mr. Scott's question. The success of green manuring depended on the management of such manures. He was constantly asked whether such and such a green manure contained more nitrogen than another kind. Such questions were almost irrelevant because success depended more on the quantity of green manures you could get into the ground than upon its constitution, provided the material had more than two per cent. of nitrogen in it. He thought that with proper management of green manures, the increase in vigour, health and crop which could be achieved in Ceylon was very considerable indeed.

Mr. C. D. Gibbon enquired if there was any advantage in resting before pruning.

Dr. Eden said it depended on the period of the cycle at which resting was done. He had had good results by allowing a field which was in plucking to run away with itself and rest when it had only been plucked for a year. But if one took a field three years old from the last pruning and left it to rest before pruning one was not contributing anything to the lower canopy of foliage. The rest itself, quite apart from the question of foliage, might be the means of putting into the roots a greater reserve of starch. But that was not a thing which could be established as a general practice because, when tea was rested, there might be such an accession of growth to the bush that this would use up all the carbohydrates which it was manufacturing and also part of the previous reserves in the roots for new growth. As a method of bush rejuvenation, he would say that the more profitable way would be to prune first and in that way secure that lower canopy of foliage necessary to start off a good, new plucking table in the succeeding cycle.

Mr. Bourke asked if prunning had the effect of a shock on poor debilitated bushes.

Dr Eden said that that was not the case, it was one of those anthropomorphic analogies which did not hold. There was no such shock as took place in men and animals. Provided food reserves were present in the roots, one might expect the bush to put out new shoots and produce a healthy and vigorous growth. If that were not the case people would have abandoned collar pruning, years and years ago. Collar pruning was of course an operation which was not resorted to except with the gravest necessity but it was a better proposition up-country than at lower elevations. This was because on an up-country situation one could reasonably assume that sufficient starch reserves of food would be available to provide for the renewal of the tissues of the bushes which was not the case at low elevations. In the sense, however, in which the question was

put he did not think there was anything to be said to support the idea of a "shock" effect in pruning.

DR. GADD said that the amount of food reserves in debilitated bushes varied considerably. Some bushes had a fair amount, never very large, and others had none or practically none. When reserves were very depleted it was inadvisable to clean prune the bushes as that would result in their deaths.

The Conference then adjourned until 10 a.m. on the following day.

In opening the proceedings on the second day the CHAIRMAN said :—

It may interest you to know that the number present for our session in this hall yesterday afternoon was 320. I am very pleased to see so very many here this morning, because the papers that you will hear are of considerable interest to you, as no doubt will be the discussions that follow. After Mr. Horne's paper it is proposed to adjourn for ten or fifteen minutes for a cup of tea for which we are indebted to the Tea Propaganda Van, and thereafter we will reassemble for discussion on any points you may have to raise. I have great pleasure in calling on Mr. Lamb to read his paper.

TEA MANUFACTURE

By

J. Lamb, M. Sc., (Lond), A.R.I.C.,

A.I.C.T.A., Biochemist

Dr. Gadd and Dr. Eden have dealt with the factors which influence the health and vigour of the tea bush and its harvest. My immediate purpose is to point out how intimately these factors are connected with the ultimate success of manufacture. The quality and make of Ceylon teas are closely linked with the system of plucking to a full leaf. All our analytical work has shown that the bud and first leaf are the richest in all the precursors of liquor. The second is not far behind but the third or full leaf, although richer than the older leaves, is a poor relation of two leaves and a bud. The stalk between the second and third leaves is deficient in all respects. There is a good deal of chemical evidence that fibre and woody tissue is very rapidly laid down at the stage of development corresponding to the full leaf. Practical experience leaves no room for doubt that fibrous teas are the direct result of overmaturity in some form.

The full leaf, when free of Blister Blight, is of infinitely more value to the bush than it is to the teamaker. Dr. Gadd has pointed out that 90 per cent of the weight of the harvest come from air or rain and only 10 per cent from the soil and manure. Dr. Eden has told you that even the response to manure, depends on the amount of leaf on the bush.

It is therefore the full or third leaf which when left on the bush, is the Philosopher's stone for which we seek, and is literally capable of transmuting base leaf into good tea. Dr. Eden quoted figures obtained from his field experiments which

shew that the harvest of a tea bush is directly proportional in weight to the amount of mature leaf on the bush.

The close connection between our system of pruning and plucking and our manufacture was brought home to me by my visit to the North Indian and Pakistan tea districts in June of last year. In North India they start the season's plucking with a large weight of mature leaf on the bush and harvest everything which grows above the plucking table. In Ceylon we start a cycle of growth with very little foliage and build up the size of the bush by taking two leaves and a bud for the factory, and leaving one leaf for the bush by a system of plucking to a full leaf. Coarse plucking therefore has disastrous effects in Ceylon, compared to countries where they first ensure that the supply of foliage leaf is adequate for the crop to be produced. When the amount of foliage is thus assured, coarse plucking can be, and is practised freely, without detriment to the bush.

If we want to pluck coarse in Ceylon, we must change our technique of manufacture because methods designed for two leaves and a bud do not give satisfactory results with coarser leaf. As an instance I give you our system of withering. We wither much harder than any other producer and we can get a really tight twist and good make as a result. It is quite impossible to get a hard wither on anything more than two leaves and a bud, as the coarser leaf withers at such a different rate. If we want to pluck coarser we must take softer withers and in effect copy the North Indian method of manufacture.

Our agricultural and manufacturing methods are therefore both based on two leaves and a bud and it is essential that this should be clearly realised. In passing I may say that young banji leaf does not compare unfavourably with normal flush so long as it is taken before it hardens.

The North Indian pluckers appeared to me to be working to a much higher standard than we reach in Ceylon. Although plucking is coarse they do not pluck below the table or take immature leaf. Few planters in this hall, will, I imagine, dispute the statement that our pluckers have lowered their standards of work, but being a slow and insidious process it is difficult to assess. It seemed to me that the North Indian system of allocating definite rows in each field to individuals or families, has forced home the fact that bad plucking is against their own interests. North Indian planters are convinced that this system makes supervision much easier and more effective. Some estates in Ceylon have adopted this practice with success and I suggest that here I have given you material for the discussion which is to follow these papers.

Whatever wrangles arise over terms and conditions of employment there is no excuse for lowered standards of work, and it is sincerely to be hoped that those who claim to represent the interests of tea estate labourers will help to impress upon pluckers, the fact that by lowering the standards of work they are not only sending leaf to the factory which spoils our quality, but also robbing the bush of the very means by which it can earn next month's and next year's rice.

From the point of view of manufacture there is so much difference between a bud and two leaves and coarse leaf, that it is essential that flush should be harvested before maturing processes are too far advanced, which mean close and regular

plucking rounds. I know full well that there are many difficulties in the way of these ambitions, but I know just as well that it is useless to attempt to improve the quality of tea by improved manufacturing technique unless the standard of leaf is maintained. Having manufactured leaf from many of Dr. Eden's manurial experiments I can also assure you that manure, whether organic or inorganic, and in large or small doses, has very little apparent effect on quality.

Climatic conditions, jat, and agricultural methods, are the factors which exert the major influences upon the quality of tea and in the factory the main tasks are firstly to prevent spoilage, and secondly to produce the style required by the particular market in which the teas are sold. In general I would say that insufficient attention has been paid to the second task, and I am particularly glad to see Mr. Horne here today. I hope that the tea trade will co-operate in future conferences and also publish more information along the lines of the Market Review, for which Mr. Horne is at present responsible.

I therefore pass on to the theme of avoiding spoilage and conforming to market requirements.

I do not believe that the normal technique of manufacture, as practised in Ceylon, causes the actual loss of very much inherent quality. During the past fifteen years I have carried out, or seen, experiments with cold withering, freezing of leaf, cold rolling, high and low temperature fermentation, low temperature and vacuum drying. I have not seen any concrete evidence that any marked amounts of desirable substances are conserved by such treatments or that conversely, the ordinary methods result in any serious loss. It is possible to accentuate certain qualities, but in the long run the market wants the straightforward ordinary good quality tea. There are demands for limited quantities of specialised teas but these are usually associated with marks, districts and seasons.

All of us with even as little as fifteen years' experience of the tea industry, can recall several new ideas or machines which have been hailed as revolutionary, and claimed to put pence per pound on the value of the product. Most, if not all, of these ideas and machines are on the scrap heap and the reason usually is that some alteration of the traditional form of tea was involved. In many cases a particular specialised demand was met, but as soon as this limited demand was satisfied, the excess production was unfavourably received by the bulk of the trade. It is the intention of the T.R.I. to pursue research on new methods of manufacture as a long term policy but that is another story which I will not attempt to tell today.

I will not dwell much longer on market requirements, as Mr. Horne will have more to say on this subject, but I must remark that they are more than usually difficult to understand at the moment. I was astonished at the enormous amounts of light flaky teas which are being produced in North India and was better able to understand the complaints I heard in London in 1946 from Blenders who were having difficulty with packing these teas. Although, as a Research Worker, I curse the necessity for adhering to traditional appearance, I must admit that the demand for it is very much to Ceylon's advantage. When the world's markets accept light, flaky and fibrous teas, and refuse to pay a premium for make and quality, I shall consider it high time to ask Dr. Eden if he can find me a job in East Africa.

The rest of my address will deal mainly with the principal safeguards against spoilage in the factory. I am laying myself open to the charge of teaching Grandmother to suck eggs but I hope that, if I provoke, it will stimulate the discussion which is to follow.

First and foremost, I put damage to leaf before spreading as the major cause of spoilage. Usually, it occurs during transport, but I have known it to occur between weighing in the factory and spreading. If leaf comes to the factory at 40 lb. per bag, it should not be crammed at 80 lb. after weighing-in, for transport to the lofts. Space must be left for spreaders to stand, as if they walk about over the top of the leaf spread thickly along the whole length of the passage between the tats, they can do a tremendous amount of damage. Labourers seem to be much less careful about handling leaf than they were before the contract period, and I think that leaf damage has increased considerably. Recently, I saw a most excellent system for leaf transport on Nayabedde Estate and I hope that Mr. Francillon will give us permission to publish photographs and details in the Tea Quarterly.

With our hard Ceylon withers the avoidance of damage is essential, as damaged tissue dries out during withering, and is not only useless, but spoils infusions. In North India where the wither is very light, damage is of little or no account. I found that 50 per cent of damaged leaf was quite common, but it was scarcely noticeable after their wither. Under Ceylon conditions we cannot afford much more than 10 per cent damage, but I have frequently found much higher figures in recent months.

The North Indian Research Station at Tocklai has shewn that bacteria multiply rapidly on wet leaf and may cause soft liquors and dull infusions. From practical observations I am inclined to think that we may run into this trouble in abnormally wet weather, and advise the rapid removal of surface moisture at all times. Infection with harmful types of bacteria which is apt to be troublesome in the later stages of manufacture in North India, appears to be of little importance here and, judging from our experiments, there is no spoilage from this cause in a well run Ceylon factory. We have indications that maltiness may actually be due to a slight bacterial fermentation secondary to the normal enzymic fermentation. Investigations on this subject are being carried out at St. Coombs, but I doubt whether we can gain much control over such a secondary process. My advice, based on our present knowledge, is to adhere to the normal method of washing down machinery and equipment with plain water, and to avoid the use of disinfectants or detergents. Tea machinery and equipment should be designed and fitted to avoid accumulation of filth, and if plain water is not sufficient to keep the rolling and fermenting rooms clean, steps should be taken to remedy the basic cause rather than to resort to disinfectants and cleaning agents.

Although damage before withering is probably the major cause of direct spoilage, I believe that rolling is the process which largely determines the amount of inherent quality which is brought to the cup. Given a free hand to use any sort of machinery, it would be a fairly straightforward task, but while we are limited by the necessity for maintaining traditional appearance, the process demands much care and attention.

Firstly I think it is essential that the flush should be kept entire for at least one roll, because the wringing action is dependent on friction between leaf and leaf and the larger the units, the better the twist. Once small dhool is formed, nothing further can be done about twisting action. It is possible to hammer out the juice, but the effect on appearance is too marked for present purposes. As soon as the leaf is well twisted, or shall we say, thoroughly wrung out, rapid dhool production may proceed; especially if a high percentage of small B.O.P. and Fannings is required. If, however, the aim is to produce high percentages of large leafy grades, or long orange pekoes, the twisting action must be prolonged.

Since twisting action is largely a matter of friction between leaf and leaf, it follows that leaf movement or circulation in the roller is of paramount importance. The pressure cap tends to suppress circulation and thus defeats its own object of improving twist. If, however, a large smooth fitting is fixed on the door of the roller and this fitting is large enough to displace leaf as it goes round and round inside the jacket, circulation can be maintained under pressure.

Such a fitting must not, however, set up a pressure against the jacket as in Epicyclic-pressure rolling. This can be prevented by regulating the slope of the sides of the fitting and keeping it below 45° from the horizontal. If the faces of the fitting are anywhere steeper than 45° they will crush leaf against the jacket. The figure which answers these requirements is a true cone with a triangular cross section and base angles less than 45°.

To obtain a brisk circulation of leaf the displacement of the cone should be as large as possible. The base of the cone should, however, clear the roller jacket by one inch otherwise the jacket may jam against it. The height should be from five to six inches according to the size of the roller. The top of the cone should be slightly rounded.

(See Plates I and II).

The plain true cone is very satisfactory for first and second rolls when used in conjunction with short types of battens such as Lamont and Crescent which run out at the door. With longer types of batten such as the M & S, which do not run out at the door, the base of the cone should be fitted to the battens which must then run for a short distance up the side of the cone, and gradually merge into it. We have co-operated with the Colombo Commercial Company in the production of a cone suitable for M & S battens and this arrangement may be used for all rolls.

When a true cone is fitted to a roller to maintain circulation under pressure, our experiments indicate that there is no objection to keeping the pressure applied throughout the rolling period, and that it is no longer necessary to raise and lower the cap at intervals.

It is most unfortunate that the word "cone" was ever used in conjunction with the fittings which set up a horizontal pressure and roll leaf against the jacket of the roller instead of the table. For this process we have employed the term "Epicyclic Pressure" or E.P. rolling and we propose to adhere to this term and to describe the gadgets used as "E.P. fittings." There is not sufficient time at my disposal to go into very much detail, and so I will summarise the present position as I see it.

1. First and foremost E.P. rolling is only suitable for use with good standards of leaf. A very small amount of coarse leaf spoils the

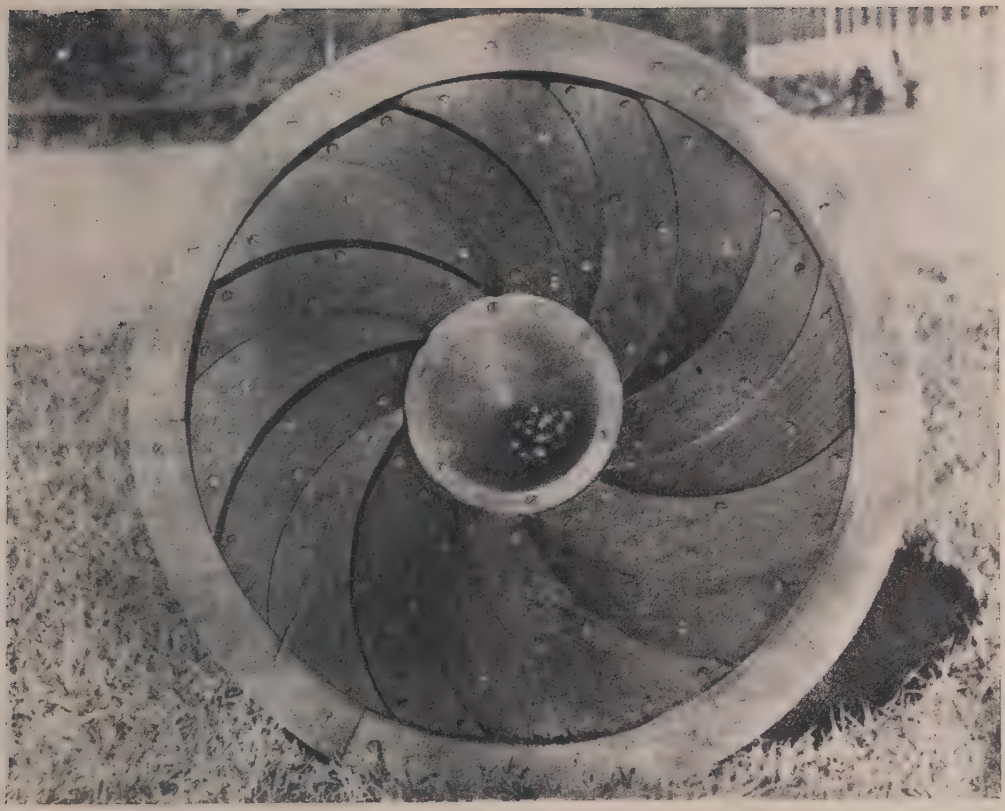

PLATE I.

PLATE II.

appearance of E.P. teas. If there is any fibre in the leaf this method of rolling tends to hammer it out and accentuate redness.

2. It requires a good standard of wither.

3. I regard it primarily as a method of saving labour and machinery. It follows, therefore, that if the rate of charge to E.P. rollers has to be reduced to obtain satisfactory results, its advantages are greatly diminised. I am critical of commercialised forms of E.P. rolling on this account.

4. The method is best suited to the production of smaller types of tea such as B.O.P. and Fannings. It cannot be expected to produce large leafy pekoes or long orange pekoes.

5. The liquoring qualities are generally acknowledged to be good. With good leaf the liquoring quality will compensate for any slight roughness of appearance, especially if B.O.P. and Fannings are the main grades. The presence of coarse leaf however, upsets this balance.

E. P. rolling is therefore a suitable method for producing good liquoring B.O.P.'s and Fannings of average standards of appearance, which is precisely what the London Blenders demanded before the war.

At the T.R.I. we have evolved two very simple types of E.P. fittings, one for first rolls, and the other for second and third rolls. They allow normal roller charges to be employed, and have been in commercial use for two years with quite satisfactory results. We believe them to be superior in design and performance to commercialised forms of fittings.

The development of E.P. rolling is clearly a matter of market requirements and our advice to estates is to avoid further conversions until the position is clarified. We will publish our findings and recommendations as soon as we have obtained sufficient clear evidence from actual sales in the open market. E.P. rolling produces a definite type of tea, and, as such, must be produced in quantities commensurate with demand. It is rash to make predictions apart from the uncertainty of the future, but I have in mind the possibility that batten and pressure cap rolling will best suit the requirements of the major number of estates selling in Colombo, and that E.P rolling will eventually prove to suit the demands of the London Blenders. The only possible policy is "Wait and See."

In dealing with E.P. rolling, I have really switched back to the subject of market requirements, from my main theme of spoilage.

To continue with spoilage I venture the opinion that in firing, grading and transport, there is relatively little loss of quality when normal care and supervision are exercised, and suitable materials are available for packing, There are one or two minor points, however, which are sometimes overlooked, although we have drawn attention to them in our publications.

The practice of storing tea hot from the driers seems to be fairly common. It is most essential to cool teas off very thoroughly as they come from the drier. Tea retains heat for very long periods when heaped or stored in boxes, and loses markedly in quality. Exposure in cooling should not, on the other hand, be too prolonged as the moisture gain will be excessive. It should be possible in a normally equipped factory to fire, cool, sift and pack the major grades, keeping the moisture

content below 4 per cent without resource to final firing. Final firing is at the best a necessary evil, but must be regarded as essential when the moisture content is in excess of 4.5 per cent.

I also strongly recommend the practice of firing big bulk on the slowest pulley with a thick spread. Big bulk may be slightly soft in the centre if fired in the same way as dhools.

In the process of grading, there are more questions of market requirement than there are of spoilage, but I express the hope that stamped aluminium will soon again become generally available, as its velvet like surface is much kinder to dry leaf than is wire mesh, and it avoids much greying.

Finally I implore you to use your moisture content apparatus if you have one, and if not, to obtain one as soon as possible. All tea makers should be capable of using this apparatus and the time involved is negligible. If teas are sent away from the factory with too high a moisture content, they will deteriorate no matter how much care and attention has been devoted to their production. As competition becomes keener, deterioration in transit will be traced back, and marks with a reputation for "going off" avoided like the plague.

In these days of universal depression I would like to end on a cheerful note. My tour of North India and East Pakistan has convinced me that our difficulties are by no means unique. Our cost of production still compares very favourably with that in North India, and with our well equipped factories, and our inherent quality, we are well able to stand up to the keen competition which we must except to the near future.

If our Labour Force and Government will co-operate with us in maintaining standards, our future is assured for many years to come. Since the Tea Industry is such a vital part of the economy of this small Island, we may, with reason, hope for such co-operation.

Chairman : I will now ask Mr. Horne to give his paper.

TEA STANDARDS

By

R. H. Horne

I believe that it is unusual for anyone so remotely connected with the T.R.I. as I am to be invited to speak at these Conferences. While being deeply appreciative of the honour, I am greatly concerned over the grave risks the Institute is running in letting loose upon you such a totally inexperienced speaker.

Further, as I was unable to be present yesterday, and as I have only just heard what Mr. Lamb has had to say, there is considerable likelihood of my covering the same ground, and also some danger of my expressing contrary views.

Before I go on to discuss better standards of tea I would like to say a few words about the people who assess those standards as far as you are concerned — the men in the Tea Trade, in Ceylon more generally referred to — to put it in its less colloquial but more polite form — as Tea Tasters.

The latter description now appears to have official recognition for the Superintendent of Census has called for a return of Tea Tasters employed by tea firms in Colombo. This would appear to imply that people are employed whose sole work it is to taste tea. I do not think that this is so in any single case. Only part of the process of marketing tea is the assessment of its worth, and even of this part the testing is not all. I suggest that experience and market knowledge play a greater part than actual tasting ability.

Should the University of Ceylon (or London or Calcutta) found a Chair of Tea Tasting (graduates no doubt receiving the degree of T.T.) I imagine that at the passing out examination a very high degree of skill and remarkable unanimity would be shown in placing in order of merit hundreds of teas.

However, I very much doubt whether anyone of these graduates would at that stage be able to take over even a small buying order and execute it satisfactorily.

The experience, the market knowledge. and the close touch with the overseas client, usually gained by personal contact, would be missing.

Tea-Tasting is not a science or an art. It is just part of the commerce of dealing in tea ; requiring some skill in assessing suitability and worth. Any tea-man will tell you "Buying is easy, its selling afterwards is the difficulty."

In much the same way the making of tea is easy but the making of tea that will command a good price is a different matter.

Tea can be made in limited quantities, and not such bad tea either, with no other material than a pair of hands, a piece of tin and a small fire. Our elaborate factories are largely a mechanisation of the same processes to enable us to deal with larger quantities.

Whether making 10 ounces of tea by the hand method or 10,000 lbs. by the factory method, given clean hands, skilful cooking and patience over wither and fermentation in the former, and adequate facilities in the latter, results will be controlled by the material used.

This may seen axiomatic and a stupid remark but there is a little more to it. It becomes a question of the degree to which the standard of the raw material affects the result.

I have seen quite a lot of Ceylon tea from the tea-man's point of view and in many cases I have been fortunate enough to have some line on what has been happening on the estate. I am absolutely convinced after twenty seven years of this that the shortest route to better tea is essentially through the standard of plucking — and of course getting the leaf to the factory fresh and undamaged.

Rapid rounds and careful and selective plucking will cost more as they require more pluckers, but I would ask you to consider your estimates and I think you will find that the cost of plucking, considering its great importance, is a surprisingly small proportion of your over-all costs.

You can spend a lot of money on machinery or factories and you may, or you may not, make better tea, but if you improve your standard of plucking you can be confident of an improved product.

In this connection I would instance the number of very old factories, with machinery to match, which, provided their crop remains within their capacity, turn out excellent tea.

I hesitate to define what I mean by a better standard of plucking as this would be going very much outside my sphere, but I hope that the matter will be well ventilated at this Conference. I would say, however, that I do not mean fine plucking in the sense of 'one and a bud" nor removing immature leaf. Just taking the flush in its optimum condition for tea-manufacture and, as it does not stay in that condition for days, getting round the estate as frequently as available labour will permit.

Unfortunately this getting round rapidly becomes of the greatest importance when it is most difficult to do so. If, in the coming April/May on the S.W. side, crop gets ahead of plucking as it did last year I am afraid we shall see a repetition of very poor prices for a heavy weight of tea. I have no doubt that all concerned will do their best to have the largest possible plucking force available at this time and will plan to be right up-to-date in the immediately preceding period.

You will note, by inference, an opinion that the rush teas of last year would not have been so poor as they were if it had been possible to keep up rounds throughout.

I have assumed, and I hope correctly, that we are all interested in producing a better standard of tea and I have started off by mentioning what I sincerely believe to be the best way of achieving it.

If I detailed why I think it is "good business" to make better tea, even if it costs more to do so, I should take up too much of your time.

In a short Interim Market Report which my firm issued some four-and-a-half months ago we put the case as well as we could in a limited space. Some of you will have seen this leaflet; for others who may be interested I have a few spare copies on this table.

The standard of Ceylon tea undoubtedly dropped considerably during the war years and I am afraid improvement since then and until quite recently has been confined to isolated cases. However, it is my opinion that there was a fairly general improvement in the second half of 1948, though the overall standard is still well below pre-war and still leaves a lot to be desired.

It has been fortunate for Ceylon that teas from other Producing Countries have not been very good over the same period and I think it is probable that Ceylon's greatly increased sales of tea to the U.S.A. in 1948—double those of 1947 and earning somewhere about 25 million U.S.A. Dollars — has been because our standard of manufacture was, over that period, ahead of India's. That country is perturbed by this loss of trade in dollars and there is now considerable activity in India aimed towards an improved standard of tea. Java and Sumatra are getting back into the field and will make every effort to resume their previous excellent standard of manufacture. Ceylon, I suggest has at present a lead but she will have to make every effort if she is to keep it.

To meet future competition we must make teas which Buyers prefer to the teas of other countries. We all know that, except for special requirements, they want colour, strength, quality and a well made leaf free from stalk and fibre. It is principally on this last point that Ceylon breaks down. Some may say "They want the tea to drink, don't they, not to look at" but, frankly, they do want it both ways and they will pay more to have it that way; or, to be more pessimistic, they will pay much less for it if its not to their liking. Incidentally, this appearance question is by no means all nonsense. Getting down to the ultimate arbiters of tea, the

housewife does not think much of a packet of tea which contains what she calls "sticks" and I do not think anyone appreciates chasing "floaters" round a tea cup.

It is generally understood, and I think correctly, that the London Market is not so sensitive about appearance as is Colombo, but I have a feeling that when the U.K. blender is once more free to choose his tea there may be a reaction against the stalky tea which he has had to put up with for these years of Control. Having failed to eliminate all stalk in the field the next move is to try again in the factory. Here the general practice is to have a large Beauty Chorus hard at work in the sifting room, none of them doing the tea any good except for the matter of taking out stalk and fibre. By the time tea has reached this part of the factory stalk and fibre have multiplied by breaking and by splitting. Useless hard banjie has turned to small flake. These women are often doing five or ten operations where one would have served at an earlier stage. So I suggest, do it earlier where you can. Sift withered leaf; train the factory staff to detect what, when manufactured, will turn out as stalk and get them into the habit of picking it out at the roller and the roll-breaker, in the fermenting leaf and at the drier feed. You need not throw it away, have receptacles at all these points and run the contents through the drier just before closing the drier down; chop it up to Bro. Mixed and Dust 2 but do keep it out of your good tea.

So far this matter of stalk and fibre is the only point actually affecting manufacture that I have touched upon. I might hazard suggestions to fire higher or lower, longer or shorter, ferment more or less but much matters cannot be generalized. Each estate on these points has to be dealt with individually and the Superintendent should get the advice, as regards what is required at any rate, from the Tea Man his Agents employ or consult.

Regarding general market requirements you will see from your prices that certain grades are in better demand than others, but again I would hesitate to be specific as these things are liable to change. For instance at present Up-country estates are getting a better price for their B.O.P. than for their B.O.P. Fannings, and many are grading accordingly. This position may easily reverse when U.K. Buyers can operate on an open market.

As regards liquor I believe that there is now a definite tendency for Out-Markets to prefer more body and colour in their teas.

Mr. Lamb may have led you to expect from me some bright ideas regarding suiting Market Requirements. I can only say that if you have turned out well made teas of a good standard you have covered the major part of those requirements. Refinements of matching type of liquor, grading and style of leaf to fluctuations in market demand have to be done very carefully and dealt with individually.

Mr. Lamb has dealt thoroughly with manufacture. While I am not qualified to be critical of factory management it is possible that occasional visits spread over a term of years assist one in noting changes that may not be so apparent to those constantly in touch. I think I might say that I notice some falling off in Factory Discipline. There is sometimes delay in spreading leaf. Withers seem to be too often regulated to suit the Teamaker's convenience and there is also slackness about windows, particularly re-opening them. Rollers are frequently overloaded to

speed up the day's work and, following that, drier spreads are increased. Sifting gets behind manufacture and un-graded tea lies about in heaps or open boxes collecting fluff that has just been blown out of other tea.

One point I would like to mention. When sending down experimental samples for examination please let the Tea Man concerned know what you have done and what you are aiming for; — it helps and results in more interest and better co-operation.

In examining teas it is not difficult to detect when a tea has been fired at much too high a temperature, but it is very difficult to discover when some quality has been lost by a temperature just a little too high. It is also difficult to decide whether a slight softness is a mild form of stewing due to too thick a spread and whether a "dry" character is due to too long a period in the drier. It is almost impossible to identify a slight underfiring as this does not show up until lack of keeping quality reveals it. Hence the importance of the Moisture Content Test.

I suggest that driers are the danger spot for loss of quality and that these should be constantly checked. Two points in this connection, tips given me by two experienced V.A.'s. Do not trust your drier to be putting the tea through in 20 minutes just because it should do so on No. 2 pulley; put a tab through and take the actual time. The belt may be slipping; — they often do in the dry atmosphere of the firing room. The other — check that your withering fans are not upsetting the drier draught.

It is probably true that a Superintendent now-a-days has less time available for field and factory work than ever before. But I suggest a full morning once a month spent in the factory, boring though it may be, is well worthwhile. Watch every step through and know exactly what is happening at each stage. With this knowledge, your brief daily visit then becomes of real value, for you can devise checks and you know at a glance if something is wrong.

I note that Mr. Lamb has made no reference to Blister Blight in relation to manufacture. Considering the prevalence of this disease last year and that fertilisers were rationed it is somewhat remarkable that tea shipments from Ceylon were the highest ever. I put it as a speculative thought that Blister Blight and the necessary precautions are more damaging to the average standard of made tea than they are to crop. Crop is maintained by having more tea in bearing in "rush" months and by the stimulated response after attacks. Both these heavier cropping periods make for poorer teas. Additional to this we have the detrimental effects of the Blight during actual periods of infection.

I apologise to experienced Planters and to keen tea-makers for the dullness of my talk but I would remind them that there are at present a number of Superintendents who have comparatively recently taken charge and to whom pre-war practices such as throwing away tippings leaf, making young leaf separately, and starting manufacture at 3 a.m. are as strange and as unheard of as, to you 10, 20 or more years ago, would be any suggestion of holding manufacture over for a day (and in some cases I believe more) to save overtime and running expenses.

Before I conclude I should add, to save Dr. Norris the trouble, that cautious phrase so often seen in the T.R.I. Quarterly "The Institute does not necessarily endorse views expressed by others than Members of the Staff."

Gentlemen, I thank you for your patient hearing. I believe that it is now time for the discussion and the arguments to start.

THE CHAIRMAN: I now invite discussion on the papers read.

COL. T. Y. WRIGHT said that when he first came to Ceylon, many years ago, pluckers carried a basket for fine leaf and a sack for coarse leaf. Fine and coarse leaf were manufactured separately and some very good teas resulted from this practice. At the present time most superintendents tried to get as much crop in as possible. Fine plucking, although very advisable would result in a reduction in crop.

Continuing, COL. WRIGHT referred to the subject of Tabloid Teas which were produced by the Tea Research Institute and which he thought were very good indeed. He asked whether it was the Blenders who were responsible for their failure.

MR. LAMB in reply said that he had no doubt that the practice of having a basket and a sack to separate fine and coarse leaf was an excellent one which would justify the extra amount of trouble. It was practised in North India until very recently but has now been abandoned and all the leaf went into one basket.

With regard to "Tabloid" teas he pointed out that the word "Tabloid" was a patent name belonging to Messrs. Burroughs & Welcome. It should be called Tablet tea. Blenders were partly responsible for the lack of development but the crux of the matter was that the present organisation of the tea trade did not allow it to accept such radical alterations

Experiments were being continued along the same lines and it was hoped that it would eventually be possible to produce a type of tea by the same basic process which would eventually conform to the requirements of the trade. In fairness to the Tea Trade it should be pointed out that theirs was the task of effecting actual sales.

MR. G. K. NEWTON said: Quite apart from the difficulty of keeping good leaf separate from poor leaf and harvesting the best leaf possible, which had been pointed out during the morning, the working planter today was faced with the difficulty of getting his pluckers to bring him the leaf which he required. They all knew that not many years ago one was able to say to one's pluckers that they had to pluck to a certain standard and if they did not do it they were punished. Things today were rather different. One heard from working planters that they were dependent upon what their labourers were prepared to do for them as opposed to what their labourers should do. He did want to make it clear that those gentlemen who kept on stressing the point of the need to have the finest quality tea perhaps did not fully realise the difficulties that the working planter was faced with today, particularly on those estates where the labour leaders made it a point to upset the labour or interfere with the quality of leaf going to the factory. (Applause).

MR. A. T. SYDNEY SMITH said be thought Mr. Newton's remarks most admirable and referred to the fact that very little picking over was now done in the field on account of various difficulties including overtime.

On the subject of quality very little had been said about Blister Blight. A lot had been said about damaged leaf producing poor quality teas but his experience was that in withering blistered leaf became pulverised.

Mr. Sydney Smith then expressed his disappointment that little had been said about the possibility of reducing the cost of production. Everything he had heard during the morning, for instance the emphasis on finer plucking, was going to make for higher cost of production. The cost of production continued to show a steady rise.

Mr. Lamb, replying first to Mr. Newton, said that the staff of the Tea Research Institute did, most emphatically, appreciated the difficulties of the working planter and drew attention to the fact that he had specially referred to such difficulties in his address. With regard to Mr. Sydney Smith's question about blistered leaf he said that the effects of blisters were the same as mechanical damage so far as manufacture was concerned. Leaf which dried out during withering caused loss of both appearance and potential liquoring quality. In severe cases light withers might limit the effects of the attack. He supported Dr. Gadd's suggestion that leaf should be harvested before white blisters developed (that is about three weeks after the actual attack) during periods when conditions greatly favoured Blister Blight. This obviated many difficulties with manufacture.

He emphasised Dr. Gadd's warning that a period of close plucking should be followed by a period of lighter treatment to allow the bush to maintain the requisite amount of foliage.

New foliage stood little chance of survival during periods of severe attack and Dr. Gadd's point was that the leaf was much better harvested than wasted. The whole emphasis of the Conference was on the functions of foliage leaf and it was of the utmost importance that the bush should be compensated for the harder plucking practices employed when conditions favour Blister Blight.

In reply to Mr. Sydney Smith's reference to the cost of production, Mr. Lamb said that all the work on tablet tea and E.P. rolling had been motivated by cost of production problems. It would be very difficult to reduce cost of production so long as the market insisted on forms of tea which rigidly conformed to traditional types.

Mr. O. L. M. Lebbe then pointed out that nothing had been said about bought leaf.

Mr. Lamb replied that if teas made from bought leaf were to compete in prices with teas made from estate leaf then the standard of bought leaf must be as high as it was on estates. He then referred to the very high standard of bought leaf he had seen during a recent visit to Morawak Korale.

Mr. Alban Wijesekera then asked whether Blister Blight actually affected quality and if the answer was "No" what was the result when the greater part of the crop was affected.

Mr. Lamb repeated his previously expressed opinion that the effect of Blister Blight on quality was the effect of the amount of damage it caused to the leaf. If leaf was very severely damaged by blisters then naturally the same quality could not be expected. He suggested that where estates were caught out with severe damage, the way to make the best of a bad situation was to take a very soft wither and to follow it up with correspondingly light rolling. Firing conditions should also be adjusted to meet the extra load of moisture. Badly blistered leaf could not stand up to a hard wither. Dr. Gadd's suggestions obviated situations of this sort.

Mr. G. K. Newton asked for information about the loss of outturn caused by long withers. He expressed doubts as to whether it was a fair question as he was under the impression that Dr. Evans had worked on it before Mr. Lamb's time.

Mr. Lamb referred to Mr. Sydney Smith as the expert on long withers. Dr. Evans had investigated the matter and published figures shewing a four to six per cent loss of dry matter. The average loss on a 48 hours wither was somewhere in the region of 4 per cent dry matter. When green leaf was spread on the tats it was still living and continued to breathe. As it was cut off from its normal food supplies it had to live on its own reserves which were in the form of starch stored in its tissues. The leaf used up 4 per cent of its own weight in a 48 hours wither.

(Note by Mr. Lamb. This approximates to a 1 per cent loss on total outturn. When a 25 per cent made tea on withered leaf is obtained in 18 hours then the loss in 48 hours is exactly 1 per cent i.e., 25 minus $\frac{4}{100} \times 25 = 24\%$).

Mr. Glen Dickson asked Mr. Horne if too much importance was not attached by blenders to "appearance" and whether it would not be a good thing for the Propaganda Board to stress that poor leaf teas could make a good cup of tea.

In reply, Mr. Horne said that Buyers, perhaps more particularly those buying for outmarkets, were definitely very leaf-conscious. He thought it would be quite impossible to take a census of world-wide public opinion regarding the point raised, and in the tea trade it had to be accepted that tea buyers were interpreting the wishes of the public or, at any rate, that they were expressing informed opinion on the teas they found sold best in packets. Mr. Horne said he had dealt with this point to some extent in his paper and the questioner would have noted that Mr. Gervas Huxley, in a talk in Canada, had stated "I have come to a firm conclusion that it is quality and not price that is the most important factor in promoting the sale of tea to the consumer." He suggested that Mr. Huxley was referring to quality in its general nature as meaning a good standard of tea, including that of a reasonably good standard of leaf.

Major Lebbe asked if there was any prospects for green tea contracts.

Mr. Horne replied that no green tea was being manufactured in Ceylon at the present time. Some green tea was being made for sale, he believed, principally in India and Pakistan. North Africa was purchasing green tea from China, probably at rates that would not be remunerative to Ceylon producers. The difficulty of marketing green tea produced in Ceylon was that all grades had to find a market. This used to be arranged by some grades going to the U.S.A., some to the U.S.S.R. and some to other destinations. At present there did not seem to be sufficient enquiry to indicate that it would be possible to place all the grades at a remunerative price.

Mr. Morford, referring to the question of short plucking rounds in the rush months, asked Mr. Horne whether he thought there was a danger that this would result in thin and poor liquoring teas.

Mr. Horne said that unfortunately records were not available as to what each estate was doing regarding plucking methods, but he would say, that, so far as his experience went, rapid rounds with a good standard of plucking produced good quality teas and he thought there was little

danger of the teas being thinner or poorer liquor in than they would otherwise be in a rush period, in fact he would rather expect the contrary.

Mr. Sydney Smith suggested that finer plucking would reduce crop and considering the present high cost of production, this was a serious point.

Mr. Horne said this was a matter which could be better dealt with by the Scientific Staff but he believed there was some reason to believe that, over a long term, a good standard of plucking at frequent intervals could be maintained without loss of crop.

Mr. Horne was asked if teas could be sent down to Colombo for sale in lots of less than six chests. In reply Mr. Horne said that for teas to be included in the public auctions the lots had to be of at least six chests — teas not included in the auctions did not receive the full attention of Buyers.

Mr. Morford said that there was a certain amount of doubt in the minds of many as to what was meant by 'close plucking' and 'closing the rounds' during times of Blister Blight attack. He also asked whether the Tea Research Institute could give a definite assurance that more careful plucking and its increased cost would not result in a heavy loss of crop. His third question was directed to Mr. Horne, He asked whether the rush crops of the spring mentioned by Mr. Horne would result in thin liquors.

Dr. Gadd briefly reviewed the development of blisters and emphasised the importance of the interval between infection and complete development. When leaves were blistered they were of little use either to the teamaker or the bush. It was not. therefore, worthwhile letting the flush stay on the bush sufficiently long for the blisters to develop. That could be prevented by 'close' rounds by which was meant shortening the interval between pluckings. By close plucking was meant the removal of flush close to the level of the plucking table. Leaf above the table should not be left to develop further when it was likely to be blistered at the next round. But the pluckers' hands should never enter the bush. Shoots developing in the bush below the plucking table must be left alone.

Plucking acted as a stimulus to the bush to produce one or more shoots to replace the one removed. From the pathological point of view it was inadvisable to stimulate a bush to produce new shoots at times when they were very liable to attack. The young leaf above the plucking table might well be taken but all growth below the table should be left alone.

The word "close" meant the shortening of the interval between pluckings, and the shortening of the length of shoot to be plucked. It did not mean stripping which usually meant taking everything that could possibly be taken.

Dr. Gadd realised that he was offering counsel of perfection. He had attempted to explain the underlying principles on which recommendations were founded. It was impossible to lay down rules to meet all the different conditions which arise during Blister Blight attacks, but if the principles were understood it would be easier to assist the bushes by appropriate action.

Dr. Eden, answering the question whether the Institute could give an assurance that close plucking would not result in a decrease of crop, said that no such assurance could be given. Neither he nor anybody else could give an assurance

as to what would happen when someone else did the job. What Dr. Gadd had suggested was correct ; the Institute's job was to give the principles, leaving them to work out their application for themselves.

He suggested that reference should be made to an article in the Tea Quarterly he wrote two years ago about hard plucking in relation to Blister Blight. Hard plucking to the fish leaf, far from affecting the crop detrimentally, had the opposite effect. In the first four-year cycle the experiment showed that fish leaf plucking gave 50 per cent more crop than did plucking to the single leaf. That was a very surprising result. It did not mean that one could continue plucking to the fish leaf indefinitely, because that altered the bush's economy. Instead of 50 per cent of the leaf being plucked and 50 per cent being left on the bush, the balance was altered to 80 per cent harvested and only 20 per cent left on the bush, later to be pruned off, to do all the work the leaves had to do in the vital physiological processes of the bush.

Although he could not give the required assurance he thought it clear that the result of what Dr. Gadd had suggested would be the harvesting of good leaf when Blister Blight was prevalent and the building up of the bush when it was not prevalent. The bush would continue to give good yields without prejudice to the formation of permanent foliage and wood.

Mr. N. M. Sanders asked whether recovery from pruning was affected more by the age of the bush than by the length of time from the previous pruning.

Dr. Eden said that he did not know what effect the age of a bush had on its recovery from pruning. He had no information to suggest that a bush 20 years old would recover more quickly than one 40 or 50 years old. The length of time between prunings, however, certainly affected because buds from say 2-year old stems normally began to grow earlier them buds on 4-year stems. The time between prunings decided the age of the stems pruned. Other factors played a part. If a bush had been rested and had a good canopy of leaves it would develop shoots more rapidly. An exception to that generalisation occurred when bushes were 'lung pruned' as the new growth on the lungs often decreased the speed at which the pruned wood produced shoots. Those observations briefly summarised the information he had on the question.

Mr. Lowry said, in regard to vegetative propagation, he had some bushes for this work which had been allowed to grow right up. At the moment they seemed to be more or less immune to Blister Blight. Should one let these resistant bushes be allowed to grow up or should they be put into plucking ?

Dr. Eden replying said his experience in this matter came from experiments on St. Coombs, some of which had been in plucking ever since Blister Blight came to the Island, and others of which were in various stages of recovery from pruning and had been allowed to run up beyond the tipping stage. Comparing the two cases it appeared that a rested bush was less susceptible to Blister Blight infection than the bush which was in active plucking. In 1947 when there were bushes of this nature it had been found that there was very little Blister Blight infection on them at all ; whereas the older portions of the flush, the third leaf of which Dr. Gadd spoke, showed that there was considerable evidence of Blister Blight infection. In 1948, however,

every leading shoot had been knocked out by Blister Blight. He thought the conclusion was that when bushes were allowed to run past the tipping stage they were not quite as susceptible to attack of Blister Blight as bushes in plucking. The programme he suggested for this business of sorting out resistant types was that when you had a bush that seemed worthwhile propagating because it had not shown Blister Blight infection, it should be pruned, say, three months before a heavy Blister Blight attack would normally be expected or perhaps, at slightly lower elevations than St. Coombs, two months before. When that bush was coming into the pre-tipping stage it would experience the full weight of the Blister Blight attack and be thoroughly tested as to resisting powers. This was the method of selection used on St. Coombs with quite appreciable success.

Mr. Alban Wijesekera said that for the last 25 years the question of controlling soil erosion had been under consideration but nothing has been done. He felt that nothing effective could be done until clean weeding was stopped. Tea estates, he considered, were the largest contributors to soil erosion in the Island. He also felt that an efficient and effective cover of weeds would prevent soil erosion to a certain extent, and hence he was in favour of establishing a cover of grass and weeds, of course, under a certain amount of control. A more thorough cover of the tea itself would also assist.

Dr. Eden replying said that the opinion had been expressed that tea estates were the greatest sinners in regard to soil erosion. The last speaker had suggested the tea itself should be encouraged to cover more ground as one of the most effective methods of preventing soil erosion. They had been talking for the last two days on subjects all of which suggested that they should get away from hard pruning, and it was hard pruning which, in his opinion, exposed so much of the ground bare to the inevitable ravages of soil erosion. One could not of course go back to a state of nature in this matter. Agriculture involved a disturbance of the settled order of nature in the interests of getting much more rapid growth than you would get in a natural condition. There were areas on St. Coombs on which they had adopted a very much lighter pruning. As a result they had a spread of the tea bush which was quite remarkable from the very early stages of the pruning cycle and they had had no difficulty in maintaining the yield through out the cycle, provided plucking was adequately attended to. He did not think that there was any doubt that one could maintain the yield if one really kept down the plucking table and saw that the bush was adequately plucked. He, therefore, quite agreed with the speaker that the increase of the spread of the tea bush should receive very great consideration not only from the point of view of yield but from that of protection of the soil.

The second suggestion was that one should grow grasses and weeds. For the last twelve years he had been struggling with this subject, and the more he saw of it the more formidable he found the problem. Until more was known about the succession of weeds on estates, that is to say, the way a particular weed or particular group of weeds could become dominant and smother everything else, efforts to do something about the weed problem in relationship to the cultivation of tea would be very futile indeed. It had been intended, following instructions given by the Board of the Tea Research Institute that these problems should receive high priority, that

such weed surveys should be carried out by himself in co-operation with Dr. Bond. It was not a survey that could be done by an Agricultural Chemist alone — it must have the co-operation of a Botanist interested in Ecology. The project fell through when Dr. Bond went away, and until more was known about that particular aspect, he would hesitate to recommend the complete abandonment of tea fields even to soft weeds. Certainly, as far as grasses were concerned, there was evidence to show that they were detrimental.

He believed that if tea was allowed to grow and spread, it would, as results in the Bulletin showed, keep weeds down to a sufficient degree to make them less harmful to the tea, while still keeping them as a very competent and effective preventative of soil erosion.

Mr. E. E. Mallawaratchie said the cost of production was based on a stand of some 3,500 trees to the acre. If that stand could be increased to 7,200 or over 7,000 it would cut down the cost of production appreciably. He enquired if alteration of the present plucking table to a barrel-shaped table would reduce cost of production.

Dr. Eden said that his answer to the first part was that 3,500 was an overestimate of the number of bushes per acre. Some time ago he had carried out an actual count of the bushes for the whole of the 300 acres of St. Coombs Estate, and allowing for roads, drains, paths and all the rest of it, it had been found that the average number of bushes per acre was just slightly over 3,000, and he thought that applied to most estates. The Institute advocated that whenever anybody was opening up new land, a stand very much greater than ,3000 should be maintained. As far as he knew, with every crop he had had anything to do, the yield per acre and the cost of production were in direct proportion to the number of bushes or plants per acre, up to at any rate a certain critical figure, which could not be exceeded on tea estates because it would not be possible to plant so many. On St. Coombs' new areas the Institute had adopted a figure of 5—6,000 plants per acre as being a good, economic stand. To attain that they were using modified contours and that met the soil erosion problem.

Mr. H. S. Hurst considered that much more use could be made of tea hedges than was now done. In fields planted fifty years ago where tea hedges had been put in the soil saved was remarkable. When supplies were being put out and some of the plants were found to be unsatisfactory they planted them in hedges. He was reminded of this by Dr. Eden's remarks about modified contours. He thought these hedges had proved to be a remarkable way of preventing the soil running away.

Dr. Eden said he quite agreed that tea hedges were a most valuable method of stopping soil erosion and that one could use extremely unpromising material out of the nursery with success. The Tea Research Institute had done it on their road edges, and of course, there was the question as to whether or not one wanted to establish tea hedges across rows which were already planted up and down the hill. He realised there would be difficulties about plucking and all that sort of thing but the soil was a wasting asset and, in his opinion, it would be worthwhile to take some trouble over tea hedges, even if it meant increased difficulty in regard to agricultural operations.

Mr. C. C. Hope said that Dr. Eden had told them that 50 per cent of the tea bush's requirements was water. They also knew that light supplied a tremendous stimulus to the bushes. In tea districts the period of greater light stimulation often coincided with drought. It appeared that there was a colossal potential wastage during that period and it occurred to him that their field engineering methods might be a little old-fashioned. He suggested that the Tea Research Institute should carry out irrigation experiments of a quantitative nature to stimulate interest in capital expenditure on irrigation.

Dr. Gadd thought that the suggestion was based on a fallacy. He said that 50 per cent of the harvested crop was derived from water. Hydrogen and oxygen were built up with carbon atoms to form sugars, starch, cellulose and other materials which became part of the tea bush. Light was essential for the manufacture of these substances but the work done was not directly proportional to the intensity of light. Too much light was as bad as too little. There was an optimum value for light intensity at which the bush worked best.

The amount of water a bush required was far in excess of that used in the manufacture of food supplies. The excess was evaporated from the leaves. Normally the bush got more water than it required, and when it didn't the first indication of the shortage was a wilting of the leaves. If the shortage persisted, as in times of drought, the bushes might die. On the majority of tea estates the bushes got their requirements from rainfall. In fact the tea areas had been selected for the purpose because the rainfall distribution was normally suitable and sufficient. If there was any intention of extending tea to areas with insufficient rain, irrigation would have to be used. But irrigation of existing tea areas in Ceylon did not appear necessary and the problems of irrigation did not arise.

Mr. Gourlay said that it might perhaps interest Mr. Hope to know that he (Mr. Gourlay) had recently seen a tea garden in Rhodesia with a rainfall of 8 to 10 inches a year, which was artificially irrigated and yielded 1,500 lbs. per acre annually.

Mr. Hope thanked Mr. Gourlay for his observation and added that he himself had seen tea irrigation in Natal where there was rainfall of 60 inches per year. But, even with that rainfall, they did irrigate.

Remarks by the Chairman

Before proceeding with my summary of this Conference, I am going to introduce you to "Little Willie." I am one of those who are keenly interested in the vegetative propagation of tea, not only in determining whether or not a particular bush is a high yielder, but at the same time the quality of the tea it produces. To roll the leaf from individual bushes my teamaker constructed this little roller.

If you feed the roller slowly with about 100 points (bud and two leaves) of withered leaf from a selected bush and roll for an hour, you will get a nicely rolled dhool. Thereafter this is fermented in the ordinary way and put into the drier in this small drying appliance which is bolted to the side of an E.C.P. drier in place of one of the small inspection windows.

I have sent down many samples for report to Colombo and it is most interesting to see the considerable variation in quality there is between the bushes that one selects. I invite you to inspect this little roller; I trust that the construction of one on similar lines may assist you to determine the quality of bushes you intend to propagate.

As Chairman of a conference such as this, one cannot but be anxious that those present should be satisfied that the papers read receive the discussion they may invite or deserve. One or two planters said after our session yesterday that the papers covered their ground so well that little appeared to be necessary in the way of question.

After thanking the readers of the various papers, the Chairman continued. There is at least one gentlemen present whose influence with labour is considerable. I appeal to him or them not to make labour conditions difficult by encouraging our labourers to do slow or careless work, for such can only react against the quantity and quality of tea producible and, therefore, the ultimate economy of the Island to which tea makes such an important contribution. Labour is the life-blood of the industry and must be contented if the best results are to be achieved.

Much has been said and appeared in print recently about the certainty that the production of tea will be equal to the demand in the not distant future, especially due to the fact that production from Indonesia is likely to increase materially when a solution of the political problems which at present impinge on every aspect of the national economy is resolved.

The production of tea from Indonesia in 1948 was about 25 million pounds. Sir Percival Griffiths and Col. Tasker paid a brief visit to Indonesia in December last; they estimate that production is likely to be :—

In 1949 — 30 to 40 million pounds.
1950 — 60 to 80 million pounds.
1951 — 90 to 100 million pounds.

I was interested to hear yesterday from H.E. the Governor-General that there is a potential market in Africa for an increase in tea consumption, for such is the opinion of the international Board, whose efforts in this field are scheduled to be intensive.

But few will deny that forward contracts on a large or Government scale tend to produce teas which are not as good as they could or ought to be. Human nature being what it is, I regard this as inevitable, whereas, with teas sold on the open market by weekly or frequent sales, one's interest is kept quickened by competition with one's neighbours and the market average.

Mr. Horne has told us this morning that the standard of Ceylon teas, even with the improvement that is evident in the latter months of 1948, is not equal to that they attained before the war. We must regain that standard and, if possible, exceed that standard; then, for certain, Ceylon teas will receive a favourable reception by tea consumers

And now I come to the moment when I am due to say farewell to three of our eminent scientists in the persons of Drs. Gadd, Eden and Tubbs.

As the Director said yesterday, the loss of these three officers with their long service and experience is of course a disaster of the first magnitude. The services of Drs. Gadd and Eden extend over 23 and 22 years respectively, and that of Dr. Tubbs over 18 years. I know you will be as conscious as I am of the desirability of continuity from all important members of the staff, especially from members of the Senior Staff. I am pleased to think that but few regard the Institute as of but little use to the tea industry and ask you to reflect for a moment what the position would have been without the Institute as a consequence of the arrival of "Blister Blight" in Dolosbage about October 1946.

Alarm was widespread, but with out scientific staff to guide us, a calmer outlook as regards its probable effect and control was soon in evidence. Especially were the efforts of Dr. Tubbs eminent in his personally unsparing efforts to convey information regarding the pest and suggesting methods of control to most, if not all, of our District Planters' Associations. In case there are some present today who were not present yesterday, I will quote what the Director said in his opening address to the effect that "Dr. Tubbs has settled down to an interesting post in the United Kingdom. Dr. Eden, whose last public appearance in Ceylon this will be, is about to apply the somewhat esoteric methods of his statistical approach to tea experimentation to the tea industry in Kenya ; while Dr. Gadd, after a long and productive term of service in the East, hopes, I think, to sit back and relax, or at least to enjoy a change of occupation from laboratory to domestic chores."

Drs. Gadd and Eden are each leaving us with a hand-book or monograph, which embodies in a readily available and practical form a record of their work with the Institute. It is so often the case that a complete file of the "Tea Quarterly," Bulletins and Annual Reports are not available in Estate Offices and, at the best, it is a tiresome matter chasing up a subject in the many publications with the help of the index ; I thank you, Drs. Gadd and Eden, for leaving with us memorials of your work.

For myself and on behalf of those assembled here and all connected with the Tea Industry of Ceylon, I extent to you, Dr. Gadd, to you Dr. Eden and to Dr. Tubbs a regretful farewell. May each one of you find profit, pleasure and contentment in the future.

I associate myself and you, gentlemen, with the Director in extending a very cordial welcome to Mr. Portsmouth. Mr. Portsmonth, you are succeeding Dr. Tubbs as Plant Physiologist. I entertain little doubt that your services will be of immense benefit to us, and I trust that your period of service with the Institute will be as pleasant and profitable as any that you have enjoyed in the past.

Again, I associate myself with the Director in his expression of appreciation to the Minister of Agriculture for his readiness and success in obtaining an increase of the cess from 14 to 25 cents per 100 lbs. made tea as from the 1st January, 1949. It will enable the Institute to expand and intensify its efforts to further the prosperity of the tea industry which is no vital a factor in the economic stability of Ceylon.

I express the thanks of the Institute and those attending the conference to the following : to the Principal of Trinity College for the use of this splendid hall ; to the Ceylon Tea Propaganda Board for sending one of their vans along to refresh us with tea at the close of the conference yesterday and this morning ; to Mr. Chas. Hope for doing his best to billet many who have attended the conference and lastly, to Dr. Norris for organising this conference and for the excellent detailed arrangements for which he is responsible.

It is gratifying that the conference has been so well attended by representatives of London interests the Planters' Association, the Agency Section, the Low-Country Products Association, proprietors, visiting agents, and working planters. Especially have I been pleased to see present such a large number of our Ceylonese friends.

I trust that all of you have been interested in the proceedings and that the

Institute has achieved and will achieve results which, as His Excellency the Governor-General remarked yesterday, will react on estates to the benefit of field and factory by those who take advantage of them.

Dr. Gadd said that he would like to thank Mr. Scott for his very kind remarks and the audience for the generous way they had been received. They were all travelling along roads with many twists and bends and he had arrived at a corner beyond which he could not see. Dr. Norris with his usual foresight had warned him of what probably lay beyond. But he was not concerned for the moment with the future so much as with the past. Looking back he saw that he had for many years travelled along an extraordinarily pleasant road encountering friends and kindliness the whole way. When he arrived in Ceylon thirty years ago on that stage of his journey he was fortunate in having as a guide a gentleman whose death occurred recently. He referred to Mr. T. Petch who at that time was Botanist and Mycologist to the Department of Agriculture and later the first Director of the Tea Research Institute. There was a little kink in the road when the Institute started work. Was the road to be rougher then ? Some had confidence and others were critical. But the road proved smooth and friendly.

As to his work he realised that his failures were his own but that his successes were mainly due to others. Bits of information were picked up here and there and when a few were successfully pieced together to make a pattern the sources of information were almost forgotten. Many pieces had come from his planting friends and some from his colleagues. His colleagues of the Senior staff were always ready to give him a helping hand. He was also grateful to the members of the Junior Staff for their support and aid in whatever way requested. He would leave Ceylon with many happy memories and he thanked them all for the very kind way they had received his efforts.

Dr. Eden then addressing the meeting said that he had now really begun to feel — what he had hardly had time to feel till then — that he was leaving the Institute. He wished to thank the Chairman and Dr. Norris very much indeed for the very kind references they had made to his association with the Institute. The best thing he could say in response to their good wishes was that he had thoroughly enjoyed his work with the Tea Research Institute. He thought there could be few people in his position so fortunate as he had been, living as he had on terms of friendship with his brother scientists and supported by the authority of the Board and the encouragement of the planting community for whom he had worked. The atmosphere of personal contact and friendship which had surrounded him had not only greatly helped his work but would be difficult to repeat in other walks of life.

He would like to endorse what Dr. Norris had said about the colleagues with whom he had the privilege of working. Scientists like other people had their ups and downs, their good points and their bad points. He remembered when he was in Australia talking about the people gathered at St. Coombs to the wife of a scientist who had formerly worked in Ceylon who asked : "Are there any other normal people there like yourselves ?" He did not feel disposed to answer that question ; all he could say was that it had been a great pleasure to him to work in Ceylon. He and his

colleagues had argued about the work in progress and how it should be done and had, he thought, succeeded in maintaining an atmosphere of friendliness which had done much to help the work forward. They were very much indebted to Dr. Norris for shewing them that differences in professional opinion should never make a difference in personal relations. He felt that he was leaving behind him a host of friends — his colleagues of both the Senior and Junior staffs and the planting community. He would feel this loss, quite frankly, very bitterly. He hoped that at some future time he might have an opportunity to come to Ceylon on a holiday and meet them again.

The Chairman, after again thanking the Visitors for attending, then closed the Conference.

On the proposal of Col. Wright the gathering passed a hearty vote of thanks to Mr. Scott for his duties in the Chair.

On the afternoon of the 22nd a large number of those attending the Conference visited the Farm School and Experimental Station of the Department of Agriculture by the kind invitation of the Principal.

The Tea Research Institute of Ceylon.

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